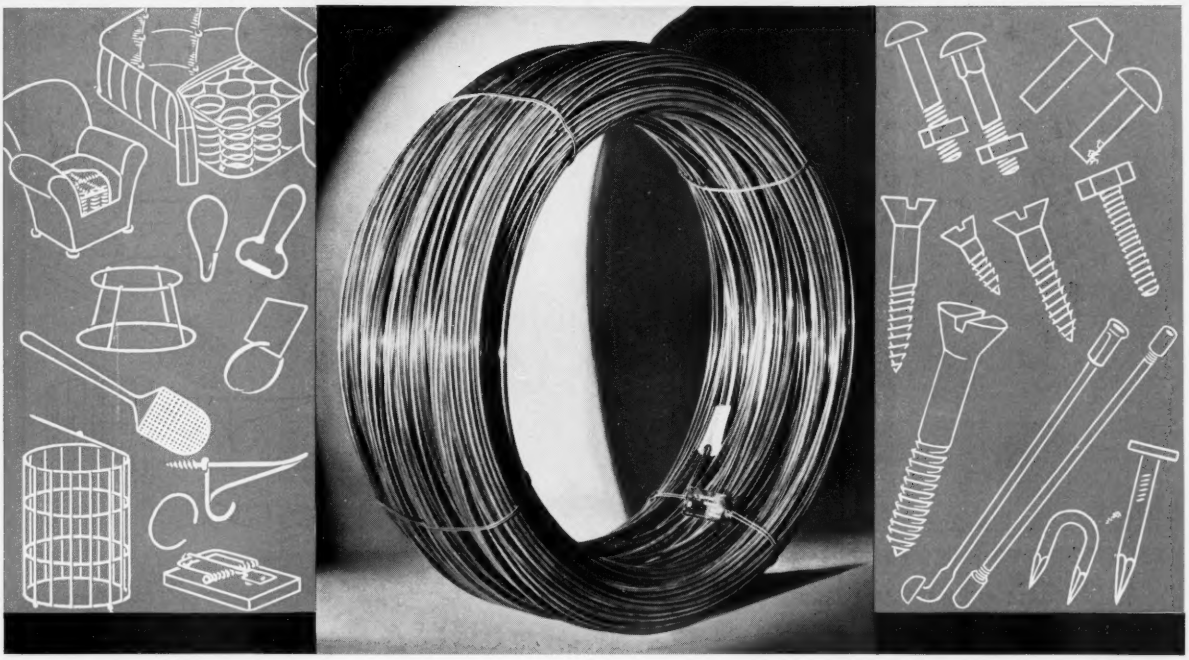
WIRE AND WIRE PRODUCTS

AUGUST 1936



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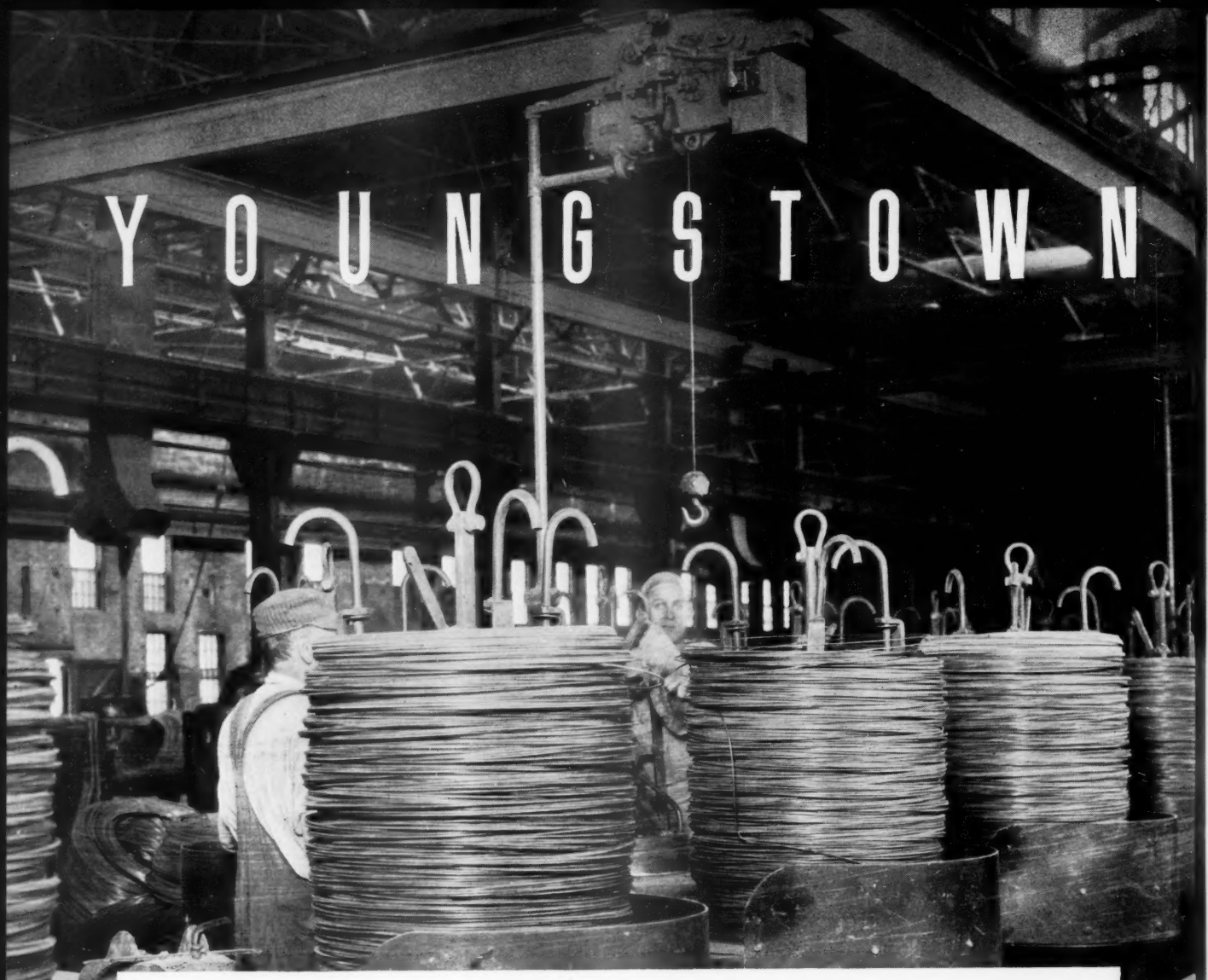

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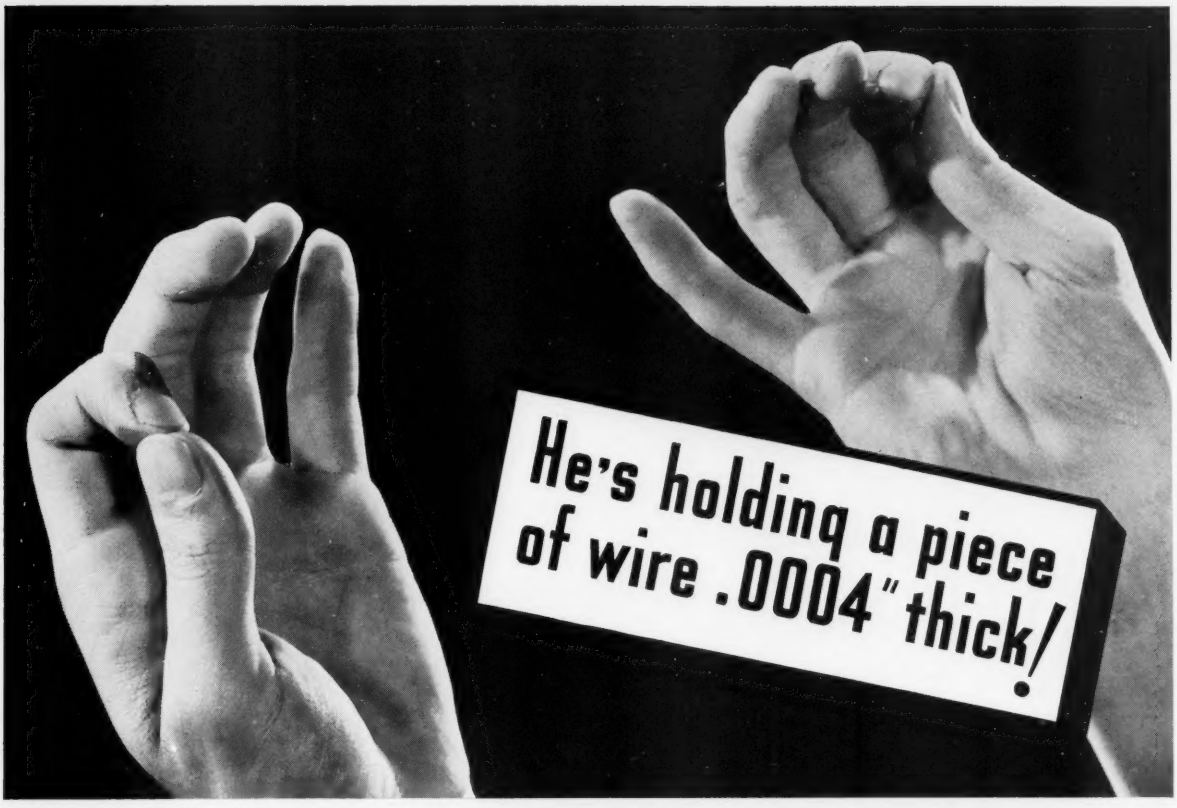

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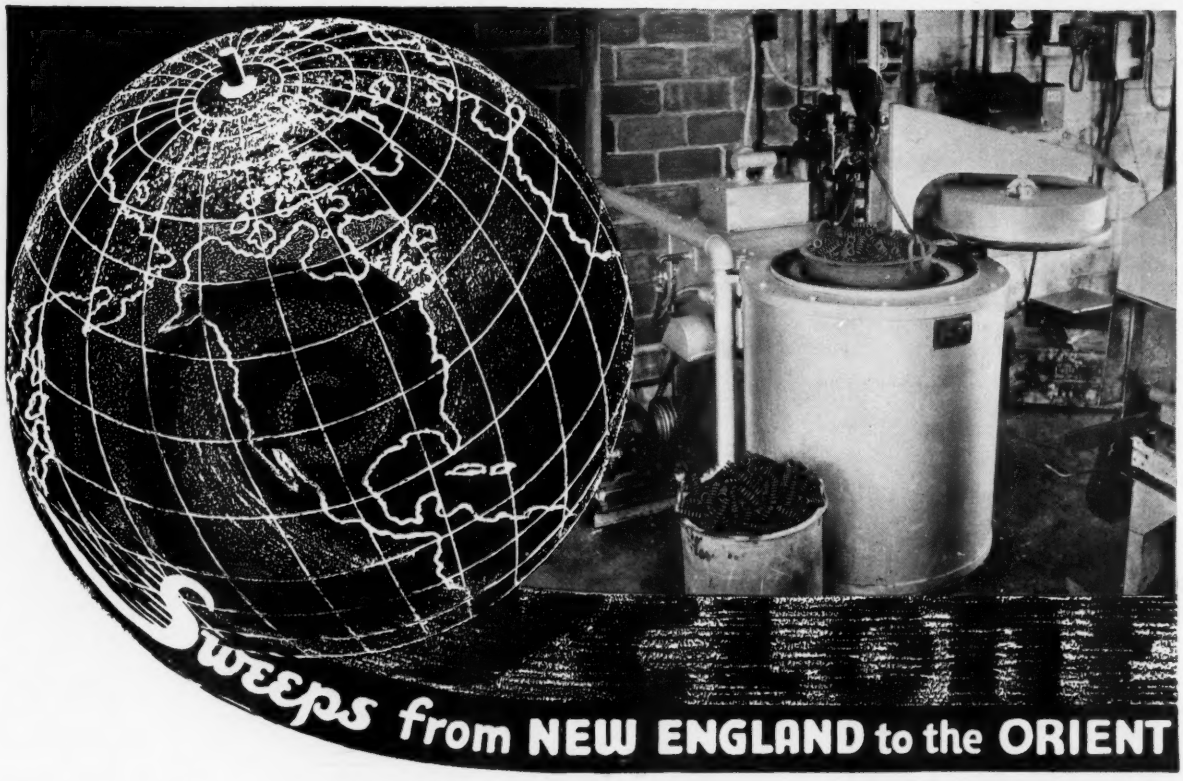

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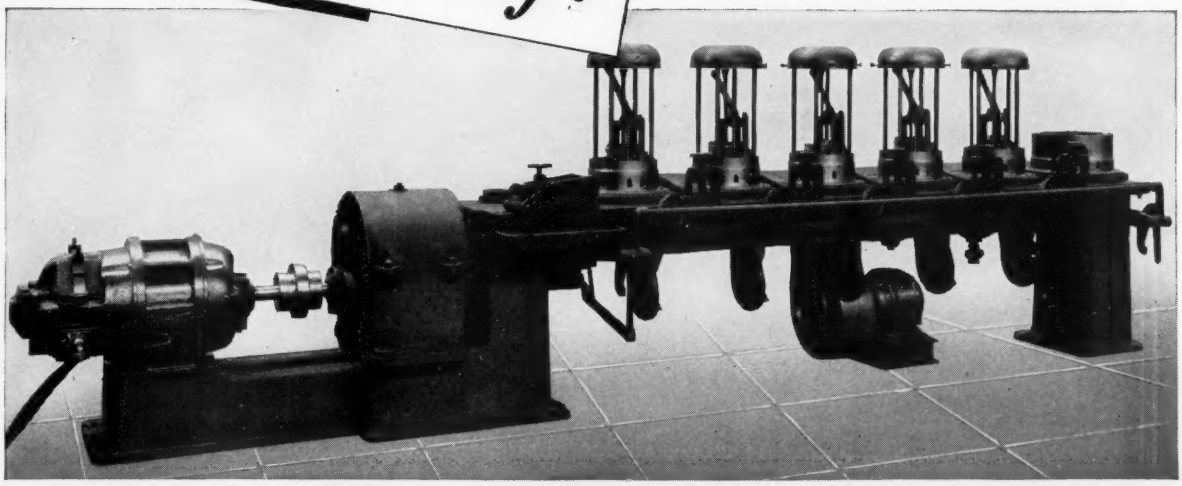

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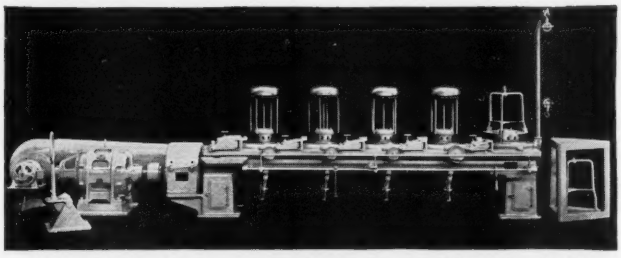
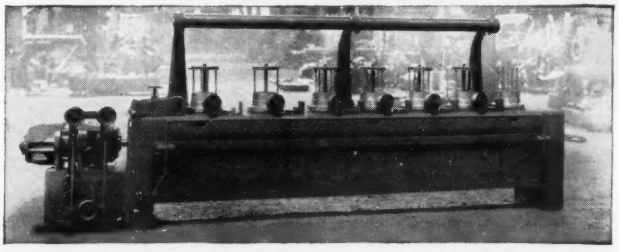
W6



Morgan-Connor Continuous Wire Machine, Type B. Fully equipped with motor and control, air-cooling system, clutches and safety stops. Designed to start from commercial No. 5 rod in either high carbon or softer grades.



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WELDING WIRE

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Richard E. Brown, Secretary

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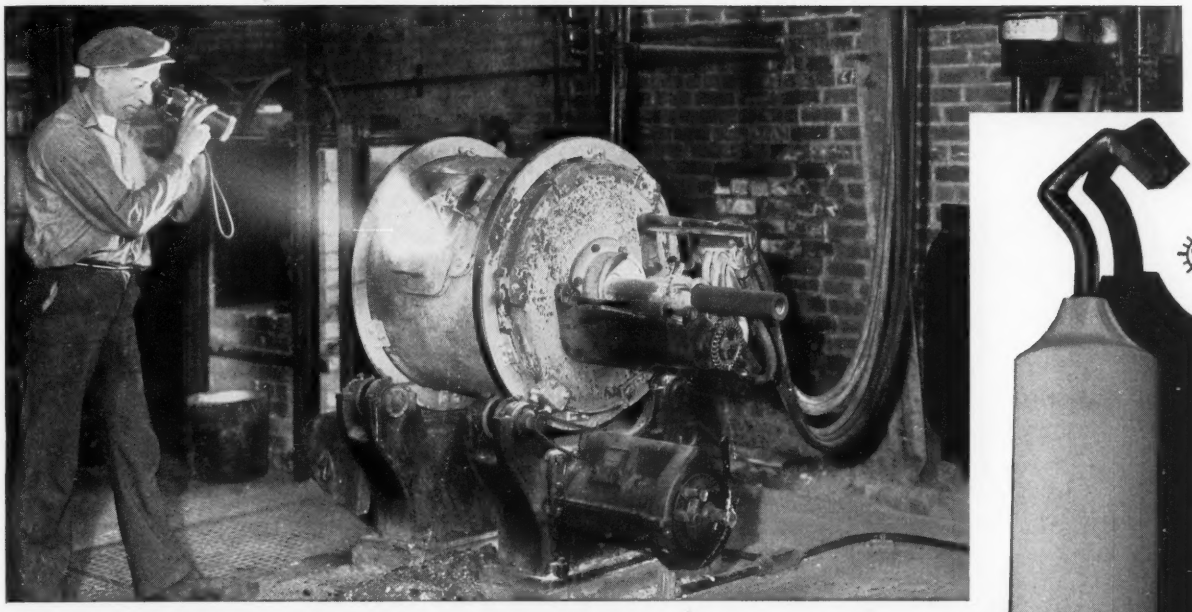

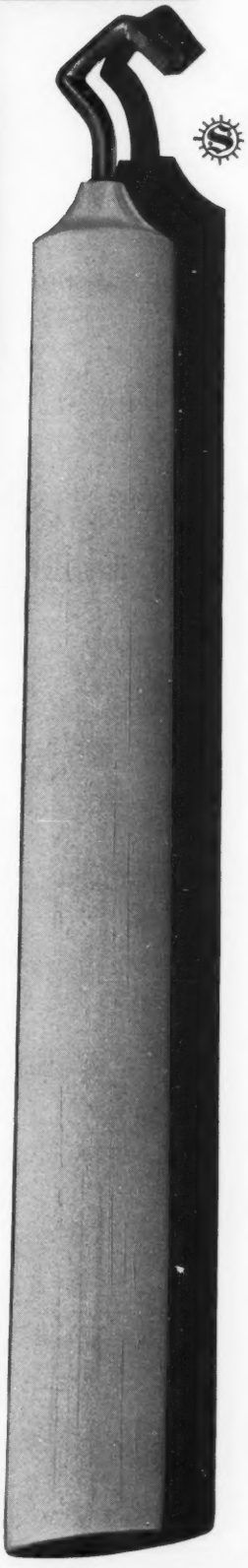

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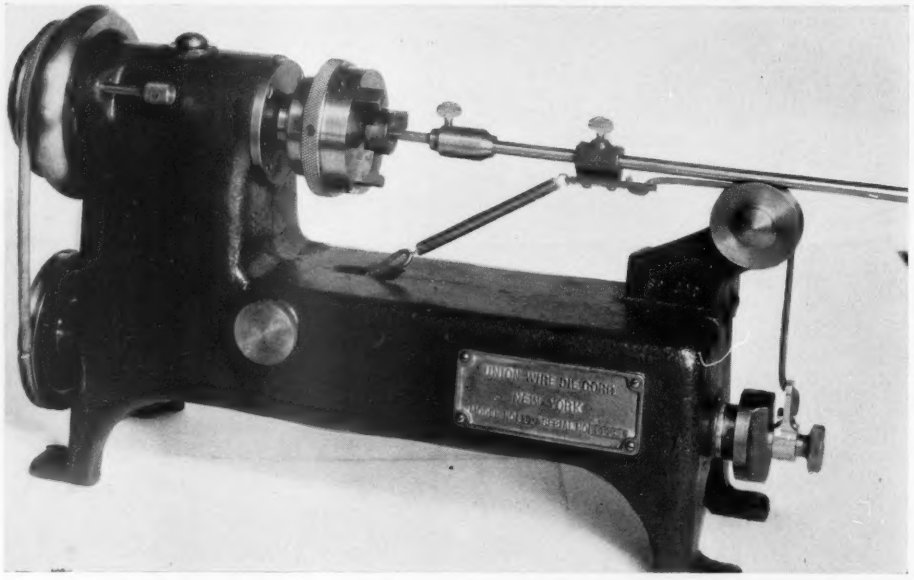

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WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip Wire Products and Insulated Wire and Cable

DRAWING—ROLLING—EXTRUDING—FORMING—FABRICATING

Vol. II August 1936 No. 8

Designated as

Official Publication By The Wire Association

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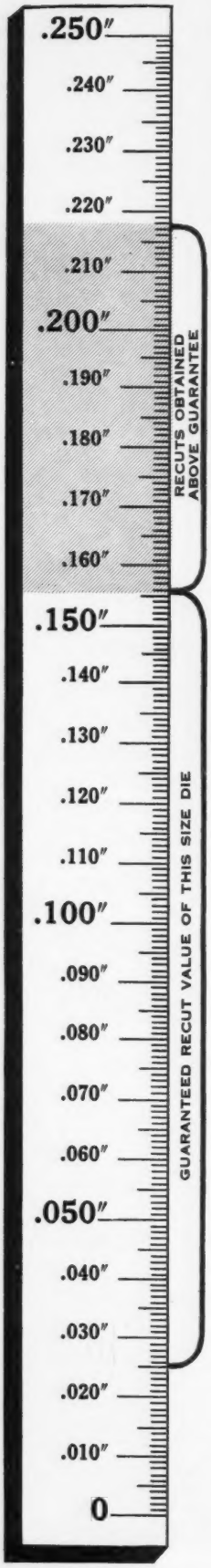

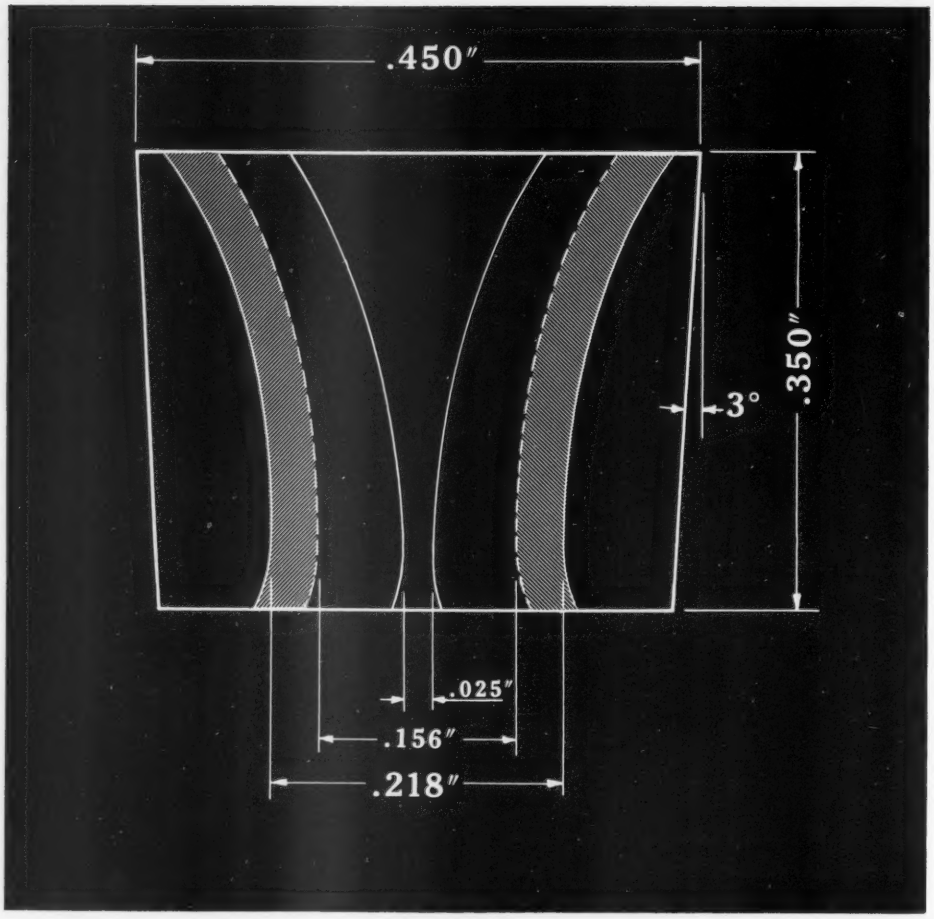

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WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.
DRAWING --- ROLLING--- EXTRUDING --- FORMING --- FABRICATING

Vol. 11 AUGUST 1936 No. 8

The Design of Mechanical Springs

By J. W. Rockefeller, Jr.,
Consulting Engineer, New York, N. Y.

That there is more to proper spring design than a slide rule and a set of charts or formulas has long been appreciated by engineers. Like other useful devices, spring formulas sometimes get out of order and produce results that are far from perfect. The following article tells some of the resaons why.

IT is doubtful indeed whether there is a single subject in the entire realm of engineering about which less is known by the average draftsman and designer of machinery than that of mechanical springs. After the Special Research Committee on Mechanical Springs (A committee of the American Society of Mechanical Engineers) was formed in 1924, a questionnaire was circulated among spring manufacturers and large users of mechanical springs in order to determine the phases of spring research in which they were most vitally interested. The returns to this questionnaire indicated that many problems were confronting the trade and also revealed beyond question that there was a marked need for the dissemination of data, already available, among those manufacturers who used springs in their products. One of the first undertakings of the committee was the preparation of a bibliography which was subsequently published and made available to the industry. Today conditions have improved somewhat. Many of the large spring manufacturing companies maintain engineering staffs capable of coping with most of the problems that arise in the field of spring design and manufacture. Some of these companies have distributed information on the subject which has merited a place in the libraries of technical institutions. On the other hand, we are still asked to fit a spring in an opening in which insufficient room has been allowed. Spring failures still occur too frequently, even in some of the most recently manufactured machinery. Purchase specifications still call for the impossible and good springs are still rejected because they do not meet specifications which are based on no sound engineering foundation.

J. W. ROCKEFELLER, JR.

Graduated from Massachusetts Institute of Technology 1921. 1921-1928, John Chatillon and Sons, New York, N. Y., from which resigned as Works Manager to enter consulting field. Has been engaged in installation of spring plants and design and production of wire springs for firms in spring, spring balance, and automotive fields. Charts for calculation of helical springs, translated into Kilo-Cm basis and adopted by Italian Engineering Standards Committee, 1926. Secretary of Spring Research Committee of American Society of Mechanical Engineers for five years and during that time representative of American Society for Steel Treating on that committee.

✦ ✦ ✦

THE majority of mechanical springs are used to meet one or more of the following requirements:

1. **Absorption of Shock.**
2. **Storage of Energy.**
3. **Measuring the Magnitude of an Imposed Load.**

Springs for the first two purposes have much in common, as contrasted with those in the third division, and will be treated together in this article. Their chief difference is that in the case of shock absorbing springs it is desirable to dissipate as much energy as possible both in deflecting and releasing the spring, while in the case of springs which are designed for the storage of energy, it is desirable that as much of the energy as possible which is used to deflect the spring, be returned in the form of useful work when the spring is permitted to return to its original dimensions.

Designated as Official Publication by the Wire Association

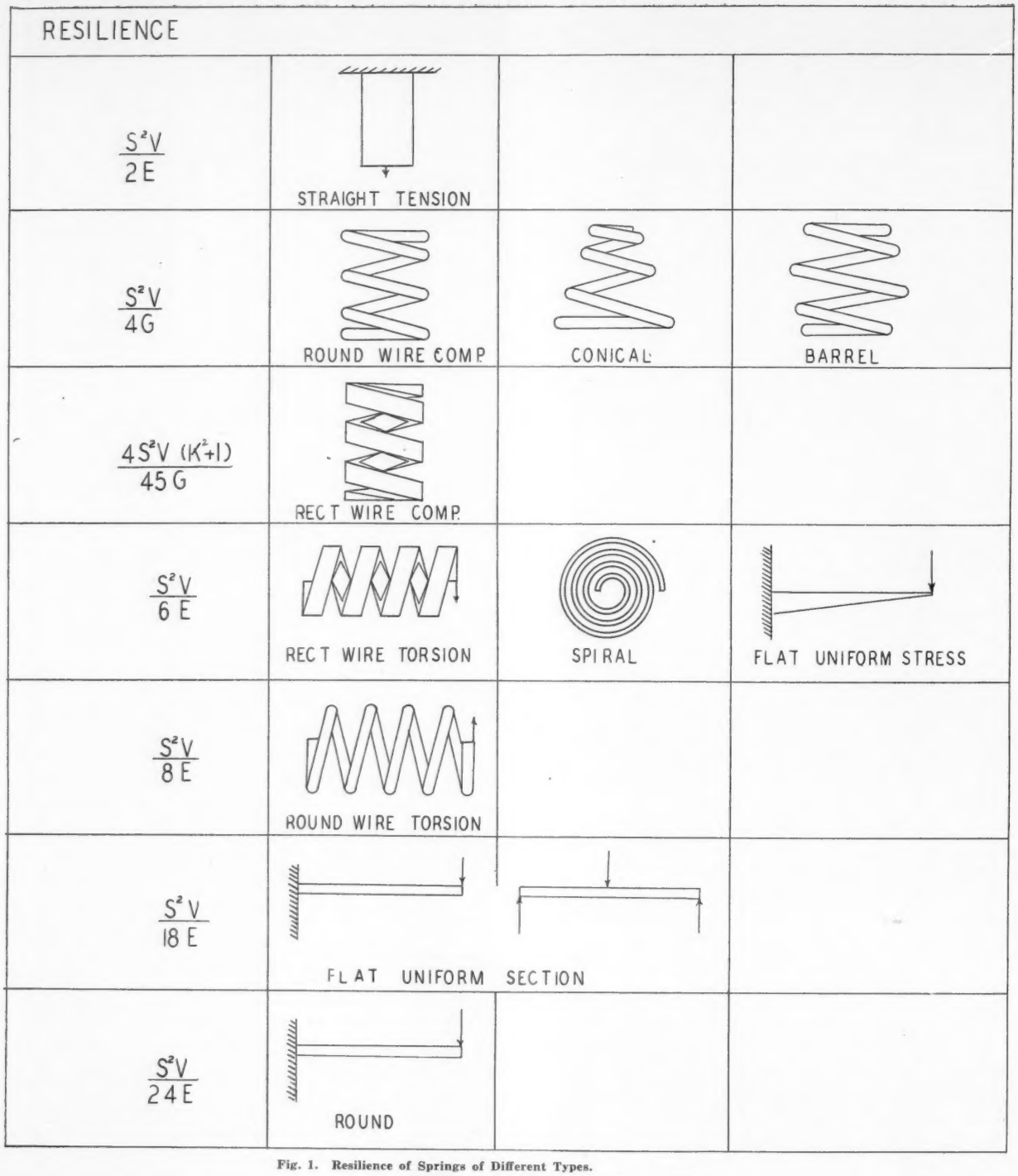

Fig. 1. Resilience of Springs of Different Types.

S.—Fibre stress (maximum) in lbs. per sq. in.
V.—Volume of material in cu. in.
E.—Modulus of Elasticity in Tension or Bending
G.—Modulus of Elasticity in Torsion
K—Ratio of short side of section to long side.

Relative Efficiency of Springs

ONE of the first things to consider in the matter of spring design is the amount of energy that may be stored for a given volume or weight of material. Fig. I gives a comparison of the theoretical energy absorbing properties of a number of types of springs in common use. It will be seen that the straight wire under tension has a greater capacity per volume of material for the absorption of energy than any other type. Rubber has been used in this form in comparatively recent times to absorb shock in the landing gear of aircraft. For materials having a higher modulus of elasticity, however, the use of such design is impracticable. A steel wire or rod, for example, hav-

ing an elastic modulus of 28,000,000 lbs. per sq. in. and stressed at 80,000 lbs. per sq. in. would have to be over one hundred feet in length in order to permit a deflection of three inches.

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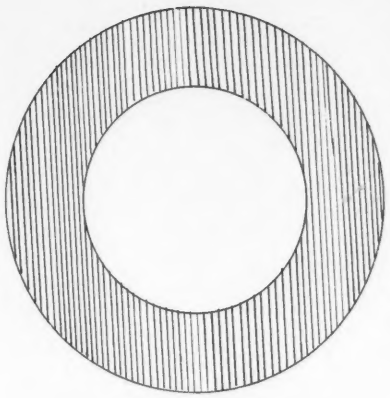
NEXT to the straight wire in efficiency is the helical conical, or barrel compression or extension spring of circular section wire or rod, in which the coils close at the same fibre stress throughout the length of the spring. Where space limitations, rather than weight of material used, are the guiding factor in the spring's design, a square or rectangular section rod may be used. The advantages of a square section wire over one of circular section in a helical compression or extension spring are that more material may be put into a space of given dimensions and the localities of maximum stress are reduced from the entire surface of the wire to a line of maximum stress on each of the four sides of the square or rectangle reducing the probability of failure through slight surface defects. The disadvantages of square section wire in helical compression or extension springs are (as mentioned above) a lower capacity for energy absorption per given weight of material and increased cost of manufacture. When stock of perfectly square section is coiled into a spring by any of the known methods of manufacture, the effect of this operation is to increase the length on the inside of the coil and decrease that on the outside, producing in the finished spring a section that is keystone. When springs are produced in large quantities, stock is sometimes used that is of keystone section to begin with and becomes square upon coiling. Since the amount of deformation that results in coiling square stock is dependent upon the coil diameter of the spring, it may be appreciated that such keystoned sections cannot be kept in stock for springs of varying diameter and that consequently the cost of producing springs that show a perfectly square or rectangular section in the finished form is considerably greater than springs of circular section stock.



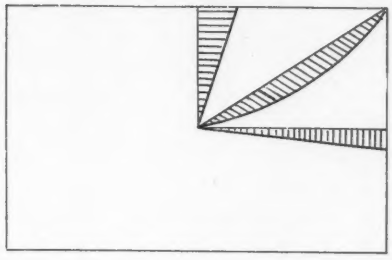


Fig. 2. Stress distribution in bars of circular and rectangular section in torsion. In the circular bar the maximum fibre stress occurs at all points on the circumference of the section. In the rectangular bar the maximum fibre stress occurs at the center of the longer sides of the section. ✦

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COMPRESSION springs of rectangular section stock are comparatively rare, although conditions sometimes justify their use. In the majority of compression springs used, it is desirable to have a flat bearing at each end, so that the ends of most of these springs are squared and ground. In such springs the end coils contribute little resilience, serving chiefly as flat washers. It has been found in practice and confirmed by mathematical analysis *(Paper by R. F. Vogt presented at the annual meeting of the A. S. M. E. Special Research Committee on Mechanical Springs Dec., 1932) that in general the number of active coils in such a spring may be taken as the total number of coils less one and one-half. In very short springs, the space taken up by these end coils is often a large portion of the total space available. By using rectangular section wire coiled on edge, the space taken up by inactive end coils can be considerably reduced, allowing that much more space in which to accommodate the springs active coils.

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IN the case of torsion springs, rectangular section rod is to be preferred to circular from a purely engineering point of view. From a manufacturing standpoint the circular section offers fewer difficulties and for this reason is wide-

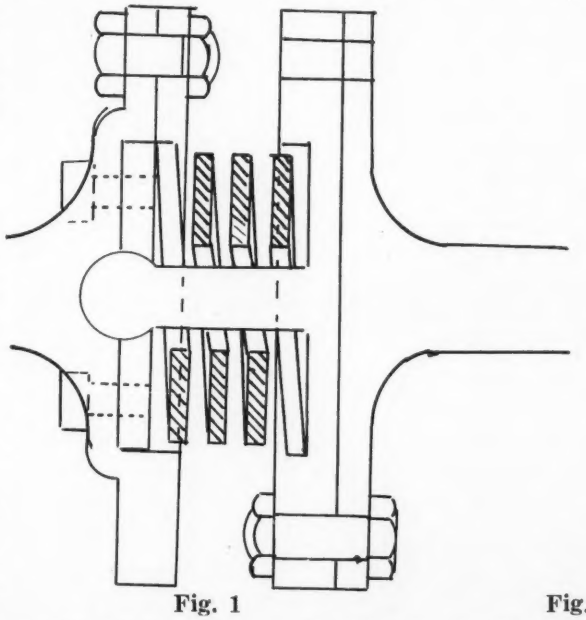

Fig. 1

Fig 2

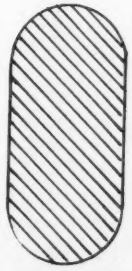

Fig. 3

Fig. 3. Springs used in both compression and torsion. (1) Flexible coupling. (2) Flexible shaft. (3) Section of Bendix spring. Springs of this type are designed for torsional stiffness and axial flexibility.

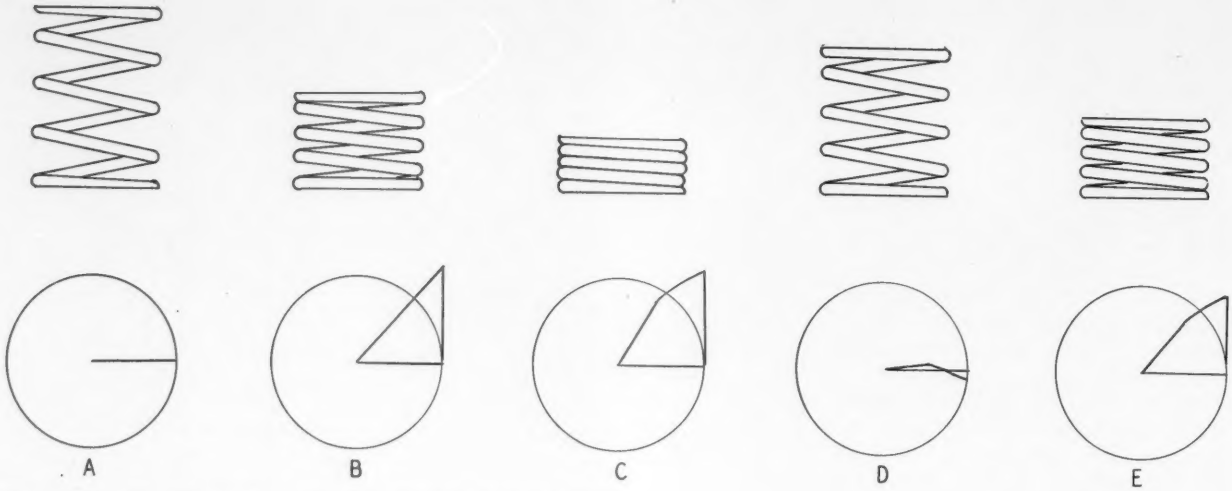

Fig. 4. Locked up stress in a helical compression spring produced by setting.
A. Spring unstressed.
B. Spring under slight deformation.
C. Spring completely closed and stressed to point at which outside fibres are stressed beyond point of complete recovery.
D. Spring released after setting.
E. Spring stressed in service. It will be noted that due to locked up stresses, the stress occuring in the outside fibres of the spring in service are less than calculated by spring formula which assumes stress to be linear function of distance from center of section. ✦ ✦ ✦

ly used in spite of its disadvantage of stress distribution. Occasionally a compromise in the form of flattened circular section wire is employed. Such wire is easier to handle than wire with square corners, although theoretically it is not capable of as such energy absorption per given weight of material.

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FLAT springs of uniform section are seldom used in large sizes, since their energy absorbing capacity is so low. Small flat springs are widely used where the duty is simply one of making electrical contact or some similar service and the energy absorbing properties are not important. They have been used successfully in certain shock absorbing mechanisms in which the general design precluded the possibility of using a helical spring.

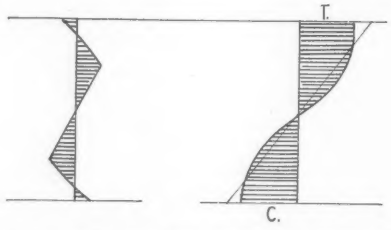

Fig. 5. Stress distribution in a spiral spring of flat wire, subjected to no outside force and under load. As in the case of the set compression spring, the fibre stress, due to locked up initial stresses is less than that calculated by formula. ✦ ✦

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SPIRAL springs of flat stock, having the same theoretical efficiency as helical torsion springs are widely used where it is desired to exert a comparatively small force over a large distance, as in the case of clocks, phonographs, mechanical toys, etc.

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IN some adaptations a helical spring must serve both as a torsion and compression member. Springs used as flexible couplings or shafts are usually required to offer a high degree of resistance torsionally and a high degree of flexibility axially. Such springs are invariably coiled of rectangular section or flattened circular

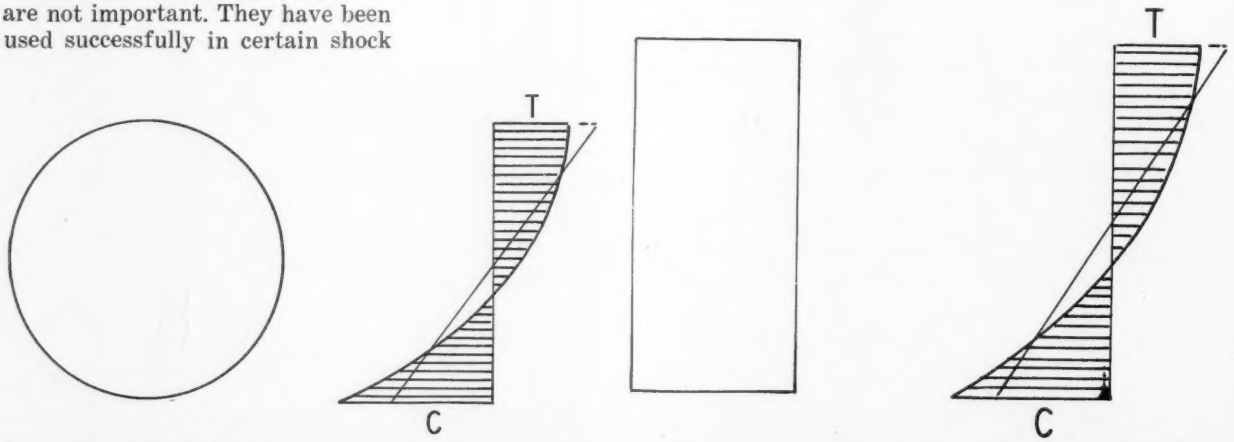

Fig. 6. Stresses in a helical torsion spring under load. In this spring the ratio of coil diameter to wire diameter is small. The fibre stress under load is not a linear function of the distance from the center line as assumed in spring formula, but is hyperbolic as shown. ✦ ✦ ✦ ✦

section stock coiled on edge. The accompanying figures (Fig. 3. 1, 2 and 3) show several examples of such springs.

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MANY charts and tables have been worked out for the calculation of springs, and can be obtained without difficulty from almost any large manufacturer of springs. It is impossible, however, to show on these charts, the many factors that must be taken into consideration in spring design. Every type of spring offers its own peculiar difficulties. In valve springs, fatigue corrosion-fatigue, harmonics and in some cases, temperature effects must be given serious attention. In certain shock absorbing springs the effect of concentrated stress is important. In scale springs, hysteresis, temperature effect on modulus, rotating effect and creep demand thought on the part of the designer, and in no case will the ordinary charts prove of any assistance in coping with these problems.

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TO enumerate some of the assumptions and limitations of the average spring formulas, tables and charts, we may cite the following.

1. That in torsion springs the stress at any point is a linear function of the distance from the neutral plane which coincides with the geometric center of the section.
2. That in helical compression and extension springs the stress is purely torsional and the stress at any point is a linear function of the distance from the neutral axis which coincides with the geometric center of the section.
3. That the material is homogeneous.
4. That the stress in a helical compression spring is unaffected by the squared end coils or the angular relation of the ends of these coils to one another.
5. That the stress is equally distributed throughout the length of the spring.
6. That the spring is concentrically loaded (In the case of helical compression springs.)
7. That the ratio of mean coil diameter to wire diameter does not affect the stress. (This is not assumed in some of the more recently published charts.)*

* This may be corrected by the formulas of Wahl or Röver, in the case of helical compression springs or by the charts accompanying this article in the case of helical torsion springs.

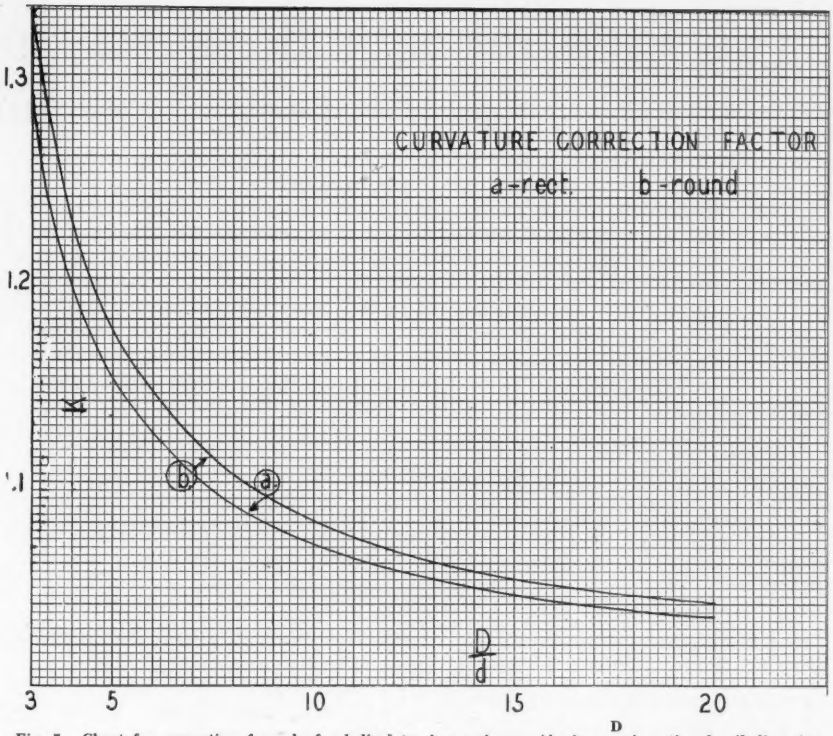

Fig. 7. Chart for correcting formula for helical torsion springs. Abscissa $\frac{D}{d}$ is ratio of coil diameter to diameter of wire. Ordinate is correction factor by which stress computed by ordinary formula must be multiplied to give correct result. It will be noted that for high ratios the correction factor is as much as 130%. ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

WHILE it is perfectly safe to make most of the above listed assumptions in many cases of spring design, there are others in which it is decidedly risky, and still others in which such assumptions result in a theoretically calculated fibre stress that is considerably in excess of the actual.

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REGARDING assumptions No. 1 and No. 2, it has long been known by practical spring makers that bulldozing or setting helical compression springs would improve their properties. When spiral clock springs have been treated in a similar manner, such springs have been able to stand calculated stresses beyond the actual strength of the material under straight tensile stress. This phenomenon is undoubtedly produced by stressing the outside fibres to a point at which they take a permanent set while the inner fibres are not stressed beyond their point of recovery. As a consequence when the spring is released from the bulldozing or setting operation both outside fibres and fibres at a point nearer the neutral plane or axis are under stress, these stresses acting in opposite directions and balancing one another. As a consequence, when the spring in this condition is again subjected to an outside force the immediate effect is to release the stress in the outer fibres while increasing that

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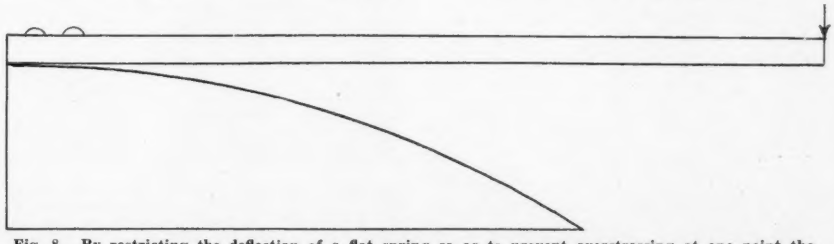

Fig. 8. By restricting the deflection of a flat spring so as to prevent overstressing at one point the efficiency may be increased to that of a tapered spring. ✦ ✦ ✦ ✦

The Preparation and Microscopic Examination of Metallic Specimens

PART I

By G. W. Pirk,
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General Cable Corp., Rome N. Y.

A study of the microscopic examination of metals published in three parts. Part I—Method of selecting sample, cutting the specimen, mounting the specimen, and polishing the specimen. Part II—Etching, both steel and copper. Part III—Results obtained from the microscopic and macroscopic examination of metals. ✦ ✦ ✦

History

THE microscopic examination of metals is part of that branch of science known as metallography. Metallography comprises all methods employed in the study of the constitution and internal structure of metals and alloys and the influence of structure, constitution, and processing procedure upon the physical and mechanical properties.

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THERE are scattered records of the microscopic examination of metals by some early investigators, but the work of Sorby in the middle of the nineteenth century was the first systematic attempt to study and differentiate the structural constituents of iron and steel. In 1875 Sorby established the practice of microscopically examining samples of rocks and thus founded the science of petrography. By 1864 he had extended and modified the technique and applied it to metals and more particularly steel. In 1886 Sorby discovered and named a characteristic constituent he found in steel. Because of its pearly appearance it was called "Pearlite". The value of the microscopic examination of metals was immediately recognized and was pursued by a number of independent investigators, namely, Martens (1878), Osmond (1880). Later the pioneer work of Sorby was continued by Arnold, Stead, Roberts-Austin, Howe, Charpy, Heycock and Neville and many others.

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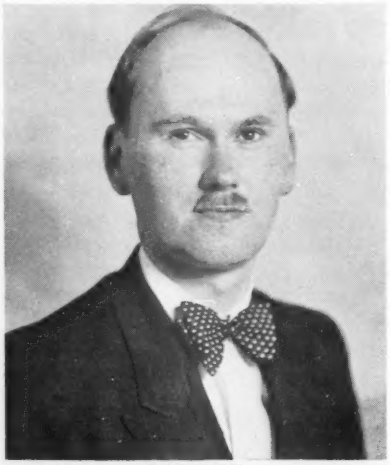
HOWE made the suggestion that the various miscrostructural constituents of steel be designated by mineralogical names to facilitate reference. Hence, crystals of pure iron were called "Ferrite", carbide of iron "Cementite", Sorby's pearly constituent "Pearlite". Later the personal names of those who first reported certain constituents were applied, thus "Sorbite" after Sorby, "Austenite" after Roberts-Austen, "Martensite" after Martens, "Ledeburite" after Ledebur, etc. Such a system of terminology can become very complex and confusing and fortunately the more recently developed metallography of the non-ferrous metals, such as copper, has avoided the pitfalls developed by the earlier systems of nomenclature.



G. W. PIRK

1923-1925. Research Assistant, Research Laboratory, General Electric Company, Schenectady, N. Y. Attended Union College Class of '29. 1929 to date. Metallurgist, Research Laboratory, General Cable Corporation, Rome, N. Y. Member, American Society for Metals.

THE microstructural constituents of a metal or alloy are formed during the process of cooling or solidification or are due to changes (transformations) in the solid state. The appearance of a structure alone will not give complete information regarding its origin or its relation to one or more other constituents.

✦ ✦ ✦

THE microscope, therefore, soon became augmented by other physical methods of study, such as thermal analysis. Microstructure was early related to other properties such as, hardness, ductility, tensile strength, etc. The correct correlation of the data with the microstructure, however, depends upon proper selection and preparation of the specimen and the correct interpretation of the features observed under the microscope.

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IN the following discussion there will be given the generally used procedures for preparing and studying specimens for microscopic examination.

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Selecting the Sample

THE specimen for microscopic examination must be selected with the same care used in obtaining a sample for chemical analysis and is the most important step in the entire examination. (13) To be of real value the sample must be chosen so as to be truly characteristic of the object it represents. The size and location of the specimen are determined by the character of the material being studied and the purpose of the examination. For example, from a rolled rod both cross and longitudinal sections should be taken. The cross

section will reveal any flaws or defects in the peripheral zones, whereas the longitudinal section will more clearly reveal the amount and distribution of foreign inclusions such as oxide in copper and slag in steel. The effect of mechanical working can best be observed by taking a section in the direction of working. In technical practice longitudinal sections are generally preferred. When studying a casting it is desirable to take samples at regular intervals over the entire cross section or at least from the center to the outside so as to reveal any differences or variations in structure. Large sections must be cut up into smaller. In many cases it is both desirable and essential to perform a preliminary examination at low magnifications of large sections, such as the cross section of a wire bar or billet. This will give general information regarding certain types of flaws, such as large gas holes, segregation, variation in casting structure, etc. After this has been performed the piece is then cut into a number of smaller sections and is minutely examined for grain size, micro-constituents, such as eutectic areas, foreign inclusions, fine porosity, etc.

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IF the material examined has failed in service samples should be taken near or at the point of failure and compared with that some distance away in order to bring out any variation in structure or non-uniformity of composition or treatment.

✦ ✦ ✦

WHEN selecting the sample thought should also be given to previous thermal treatment, for after heating the material near the peripheral zones may be altered. (13) For example, steel may be decarburized, brass may lose zinc, copper may absorb sulphur from the annealing atmosphere, etc. In case hardened steel sections the surface structure is decidedly altered by the absorption of carbon. A cross section is generally best to demonstrate the depth of penetration or diffusion of one metal into another, such as carbon during case hardening or chromium during chromizing. Cross sections are also most suitable generally for studying the thickness and uniformity of electro-deposits on wires or other shapes. Sections such as rails, webs, channels and other structural shapes are usually cross sectioned and examined in their entirety for general characteristics and then cut into small sections for minute micro examination.

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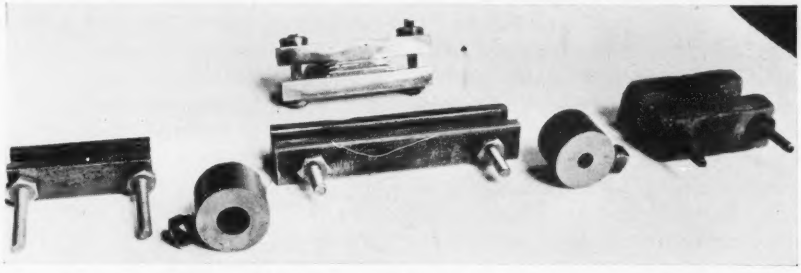

Fig. 1. Shows Various Types of Clamps Used for Mounting Small Specimens. ✦ ✦ ✦

WHEN selecting specimens for microscopic examination the value of the observations will be enhanced if it is remembered that the most important factors of any micro-examination are (1) the purpose of the examination and (2) the previous history of the metal, and (3) what information is being sought.

✦ ✦ ✦

Cutting the Specimen

AFTER definitely determining the location of the specimen to be examined, the next step is to cut the sample.

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DURING cutting care must be taken not to alter the structure of the specimen. (13) Heat treated alloys, such as steel, etc., are very susceptible to heating effects and even careful grinding on an uncooled grinding wheel may generate sufficient heat to bring about structural changes.

✦ ✦ ✦

FOR the cutting of such metals as copper, iron, untreated steel, aluminum, etc., the hack saw will generally be a satisfactory and convenient tool. When specimens are to be cut from large castings or ingots a portion is first cut out on a power saw, milling machine or other convenient machine tool. Hard and brittle materials are most readily cut by means of a carborundum disc which is well cooled with water or other coolant.

✦ ✦ ✦

HEATING and excessive distortion of the metal by pressure must be avoided during all cutting operations. Such precautions are especially important with the softer metals.

✦ ✦ ✦

DURING the cutting of specimens the oxy-acetylene torch must be avoided if one expects to obtain a representative section of the metal being examined. The intense heat of the flame completely obliterates any structural peculiarities of the metal and so renders the results of the examination worthless. Even a slight rise in temperature is sufficient to cause alteration in the structure of hardened steel.

✦ ✦ ✦

Mounting the Specimen

SPECIMENS whenever possible are cut to such a size that they can be conveniently handled; for example, ¾ to one inch square or diameter and ½ inch thick. If the specimen is over one half inch thick it is difficult to maintain a flat surface during polishing.

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SAMPLES too small to be handled conveniently must be mounted. Various methods for mounting are used, depending on the size and shape of the specimen.

✦ ✦ ✦

SHEET specimens are formed in a pack and held in a clamp similar to those shown in Fig. 1. Sometimes "filler" sheets of a softer metal foil are alternated with the steel sheets in order to obtain greater compactness and to preserve surface irregularities.

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WHEN heat is not objectionable, wires and ferrous materials are mounted in fusible alloys such as 50-50 lead-tin solder, Woods metal, etc.; Sulphur is widely used because of its low melting, but it may pit steel or discolor copper.

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SMALL wires and odd shapes are generally mounted in fusible alloy, whereas larger sizes such as ¼ inch rod are more conveniently held in clamps. Bakelite powder molded under pressure makes an admirable mounting material when heat is not objectionable and is superior to fusible alloys and solder, (H. M. Schleiker and J. L. Everhart, Metals and Alloys, Vol. 5, March 1934, Page 59 and E. H. Dix, Jr. Chemical and Metallurgical Engineering, Vol. 27, page 1217, (1922). (1)

✦ ✦ ✦

POLISHING has a tendency to round the edges of the specimen. This is of little consequence except when it is necessary to examine the edges for defects, etc. To preserve the edges they are sometimes copper plated prior to mounting. Filaments of tungsten wire are embedded in copper blocks by pressure. The wire is placed on a copper block with a plane surface and a hardened steel plate with a smooth surface is placed on top and the whole compressed in a press or other device. When the steel block is removed the filament will be found embedded in the copper.

✦ ✦ ✦

Polishing the Specimen

CUTTING or sawing, even if carefully performed, leaves the surface too rough and distorted for a microscopic examination. The purpose of grinding and final polishing is to remove these distorted layers so that the metal can be studied in the condition in which it actually exists.

✦ ✦ ✦

THE forced polish left by buffing is also not suitable for metallographic work since it leaves the surface badly distorted and smeared.

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GRINDING and polishing are generally carried out in three or more steps:

1. **Rough grinding or filing to obtain a flat surface**
2. **Rough polishing**
3. **Fine polishing generally including two or more steps.**

✦ ✦ ✦

ROUGH grinding may be done entirely by hand with a file or on a grinding wheel. For softer metals such as copper, aluminum, iron, and soft steel, files of varying grades of fineness may be used starting of course with the coarser grades and working down to the finer. If a grinding wheel is available this may be used, but it should be copiously supplied with water. For the hard metals such as tungsten, hardened steel, white cast iron and similar alloys, a medium fine and medium hard grinding wheel is used. The wheel may be either horizontally or vertically mounted and may be run at speeds up to 1200 R. P. M. Although the faster running wheels may grind somewhat faster they also generate heat more rapidly and increase the difficulty of keeping the sample cool so as to prevent any thermal effects.

✦ ✦ ✦

WHEN a file is used it is preferable to grip the file in the vise and rub the specimen on it instead of clamping the sample in the vise and distorting it even slightly. In order to determine when the marks from the previous grinding are removed the sample is rotated through an angle of 90 degrees.

✦ ✦ ✦

MAGNESIUM, zinc, tin and lead because of their softness and low recrystallization temperatures require special polishing procedures.

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ROUGH polishing follows the grinding operation and may be performed in one of several ways. The specimen may be rubbed on a series of graded French emery papers, starting at 1, and gradually proceeding to the finer grades, such as 0, 00, and 000 papers. Some prefer to finish the rough polishing operation on a 0000 French paper. When going from one grade paper to the next finer the sample should be rotated through 90°. Rubbing should be in a straight line to and from the operator, applying just enough pressure to keep the sample firmly in contact with the paper and also avoiding any rocking motion as this has a tendency to produce a curved surface difficult to examine on the microscope.

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THE emery papers may also be glued to vertical discs rotating at 600 R. P. M. although higher speeds have been successfully used. In each case the papers should be backed by a plane hard surface. There is one main objection to this method and that is heating and alteration of the surface are practically impossible to avoid. Its chief merit lies in the fact that it is rapid and easy to perform and is therefore useful for many commercial applications where heating is of little consequence and produces no structural changes.

✦ ✦ ✦

THE preliminary grinding and subsequent paper work is of tremendous importance and should not be hurried or carelessly performed, since any imperfections introduced will not be removed by the final polishing operations. If the early work has been neglected, the surface after the final polish will be in a worked condition and on etching will develop cross marks, scratches or even a general surface roughness which will obscure the true structural details. Observations made on an improperly prepared surface have no significance other than to indicate that some part of the polishing procedure has been improperly carried out.

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WHEN polishing copper, some prefer to omit the hand grinding on emery papers and replace it by cloth covered power driven wheels. This operation is generally performed in two steps. The first wheel is covered with 8-12 oz. canvas duck on which FF Turkish emery, No. 500 carborundum or powdered alumina are used.

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THE powder may be directly applied to the wheel and kept wet by dripping water or a suspension of the abrasive in water may be

applied to the wheel from a bottle or with a brush. When the marks from the preceding grinding step are removed the sample is ready for the second wheel which is covered with wool broadcloth and on which tripoli is used as the abrasive. This wheel must also be kept wet continuously. To insure an even polishing effect and uniform wear of the polishing wheel the specimen should be slowly moved in the reverse direction to the polishing disc and from the center to the outside.

✦ ✦ ✦

TWO felt covered wheels sometimes replace the broadcloth covered wheel since felt retains the abrasive better. The first felt covered wheel uses "RF" grade emery flour and the second "S F 6 X" emery. When going from grinding or polishing step to the next the sample should be thoroughly washed free from any polishing material.

✦ ✦ ✦

IT is possible to do good work without the use of power driven polishing wheels. In small shops where the volume of metallographic work is not great or in plants where microscopic examinations are only performed occasionally, the hand method, although slower, serves very well.

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THE final polishing of copper may be performed either by hand or on a wheel covered by a fine grade of woolen broadcloth sometimes referred to as "kitten's ear" broadcloth. Chamois has been used but has a tendency to drag the metal unnecessarily. Water suspensions of either levigated alumina or very finely powdered magnesium oxide may be used as abrasives, the wheel being kept constantly wet by dripping water. The writer has used magnesium oxide and has applied it as a dry powder, the wheel being kept wet by dripping or pouring distilled water on as needed.

✦ ✦ ✦

WHEN magnesium oxide is used as a polishing powder the cloth should be thoroughly rinsed in water and when not in use, kept in water containing 2-3% hydrochloric acid. If this is not done and the cloth left exposed to air it will absorb CO_2 and cake.

✦ ✦ ✦

COPPER and its alloys can be polished by hand if no other means are available. The specimen is taken from the file through the 0000 emery paper and then directly to the final polishing procedure, conducted as follows. The polishing cloth is stretched over a piece of heavy plate glass and is moistened with water containing a few cubic centimeters of concentrated ammonia per liter. The rouge is then applied either as a thick paste or as a thick suspension in water containing a few cubic centimeters of ammonia and the sample rubbed to and fro as in grinding on emery paper. This really is a combination light etch and polish. The quantity of ammonia should not be too great or else fine particles of copper oxide will be dissolved out and the surface considerably attacked. When this procedure is properly carried out a high polish suitable for examination at high magnification can be obtained in 10-15 minutes.

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THE sample should be frequently removed, rinsed under tap water and inspected with a 6x hand glass in order to determine the progress of the polishing. The cloth should be kept thoroughly wetted with the ammonia solution mentioned above. After polishing the sample should be thoroughly washed in soft soap and water to remove the polishing abrasive and any traces of ammonia which might attack the surface. It is then swabbed in absolute alcohol and dried. If clean compressed air is at hand the alcohol rinse may be omitted and the sample dried by the air blast. When an air blast is not available a hair drier will dry the specimens satisfactorily. Rouge may also be used on the final polishing wheel instead of alumina or magnesium oxide.

✦ ✦ ✦

PURE copper is more difficult to polish than are its alloys, since a practically perfect surface is essential to the detection and examination of copper oxide, especially since this is most easily done on a polished unetched surface.

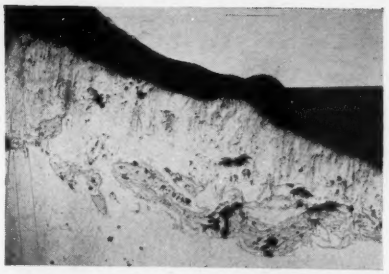

Fig. 2. Polished Surface of Copper Illustrating Porosity (Black Areas) and a Constituent Having Both a Different Color and Hardness From That of Copper, Namely, Copper Oxide X100. ✦

FIG. 2 shows an unetched surface prepared by this method and clearly shows the high polish and the oxide and black areas which are porous spots.

✦ ✦ ✦

THE final polish on ferrous (16) material may be performed by one of the following methods. (1) The sample is taken from the polishing paper to a cloth covered wheel running at 300-400 R. P. M. White reground tripoli or No. 600 alundum powder is used as an abrasive. A very fine broadcloth is used, which should not be too thick or have a "nap" as this will lead to relief polishing.

✦ ✦ ✦

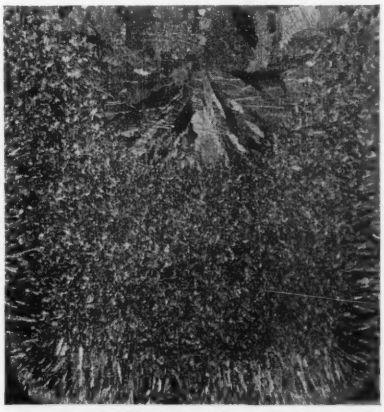

Fig. 2B. Shows Another Typical Structure Found in a Brand of Commercial Wire Bar. Note the Fine Grain Size Compared With That of the Copper Bar Shown in Fig. 2A. Full Size. ✦

THE last step may be performed on a wheel using very fine levigated alumina No. 3 or with "superfine" magnesia powder. A good grade of soft jeweler's rouge may also be used. The writer has obtained good polishing on annealed and also on hardened steel samples by going directly from the

No. 000 or No. 0000 polishing paper to a broadcloth covered wheel using rouge suspended in water as the polishing medium. At first a fairly heavy suspension is used which is gradually diluted to a relatively "thin" suspension as polishing proceeds.

✦ ✦ ✦

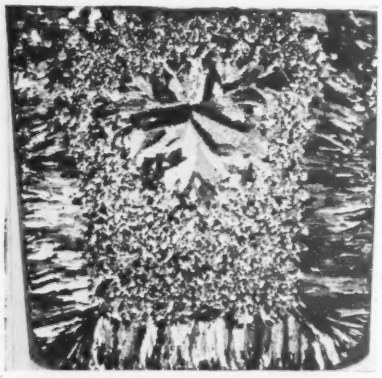

Fig. 2A Shows Typical Structures Found in a Common Brand of Commercial Copper Wire Bar. Full Size. ✦ ✦ ✦ ✦ ✦ ✦

AS an alternative procedure the following method may be employed. Four cloth covered wheels running at about 350-400 R. P. M. are used. Very fine wool broadcloth is generally used on the first three wheels and silk broadcloth or velveteen cloth on the final wheel. No. 320 alundum, No. 600 alundum and levigated alumina are used on the first three wheels and very fine magnesium oxide powder on the final wheel. It is best to apply the alundum and levigated alumina as water suspension and the magnesia as a dry powder, to the moistened cloth. The magnesia should be rubbed in with the fingers. Any coarse particles can thus be felt and wiped toward the edge of the disc.

✦ ✦ ✦

Precautions

DURING all wet polishing operations the sample should be continuously turned about its vertical axis and moved to and from the periphery of the wheel in order to avoid pitting. The cloth should be kept wet during all polishing procedures. Except in certain rare instances or when using special polishing procedures it is advisable to use much water and a relatively small amount of abrasive. Excessive polishing may produce bad pitting. When going from one grade of abrasive to the next finer the specimen should be thoroughly washed in order to avoid carrying over any of the coarser abrasive.

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IT is also important to avoid using excessive pressure in an attempt to hasten polishing. Heavy pressure will not only cause excessive surface flow of metal but may also lead to pitting. If it is necessary to interrupt any of the wet polishing steps even if only for a few minutes the sample should be thoroughly washed and well dried. Non-ferrous samples if left wet will discolor or corrode, whereas iron and its alloys will become pitted by rust.

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WHEN the final polish has been completed the sample should be immediately washed free from abrasive, rinsed in absolute alcohol, dried and placed in a dessicator until it is wanted for microscopic examination or etching.

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THERE are many variations of the above procedure all of which yield good results when properly used.

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The Polished Surface

AFTER the final polish the sample should be free from scratches when examined under the microscope and should present a mirror and featureless surface unless one of the following conditions prevail.

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(1) THE constitutents are of a different color. This is so in the case of ordinary commercial copper where the oxide is bluish compared with the salmon color of copper. In cast iron graphite appears as black flakes. Most of the aluminum alloys also have constituents which have a contrasting color and stand out on the polished surface. (13)

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(2) THE constituents vary in hardness. Where this condition exists selective polishing will take place and one of the constituents will wear faster than the other, leaving one standing in relief. Copper again is a good example, the oxide standing out and being readily distinguishable by its color. In the white bearing metals which contain copper and antimony the Cu-Sb antimony constituent will stand out.

✦ ✦ ✦

(3) THE metal is porous. In this instance there will be seen black spots and cavities over the entire surface or a portion of it. These cavities act as dirt and grit collectors and should be carefully washed out after each step in the polishing procedure. If a specimen having many cracks or pits is to be examined these should be filled with some plastic material such as paraffin or shellac.

✦ ✦ ✦

IT is always advisable to examine a polished surface before etching, since at times much information regarding the size and distribution of a constituent can be learned as for instance graphite in cast iron and foreign inclusions of various types in steel, copper oxide, in copper etc.

✦ ✦ ✦

— END OF PART I —

Part II—Etching—Steel and Copper —will be published in the September issue.

Part III—Results Obtained from the Microscopic and Macroscopic Examination of Metals—will be published in the November issue.

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(Please turn to Page 404)

Historical Data Relating To Hot Galvanizing Practice For Wire

By J. L. Schueler,
Superintendent, Steel & Wire Division, Continental Steel Corp., Kokomo, Indiana.

An outline of the development of the hot galvanizing process together with a description of the various processes now in use for the galvanizing of wire. ✦ ✦

THE published literature on galvanizing is voluminous, so that in this article we will only touch some of the high spots with reference to the galvanizing of wire. Naturally, since the history of zinc coating is tied up with that of the metal, zinc, perhaps a short outline of the history of this metal would not be amiss.

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THROUGH use, the term "galvanizing" has become synonymous with "zinc coating", called, also, "spelter" coating. The word zinc seems to have been derived from zincken, or zacken, the German term for nails or spikes, because in preparing brass, a part of the ore on submission to a preparatory roasting, often assumed such forms. The word "spelter" was probably derived from "spianter", or "spialter", terms introduced in the latter part of the 17th century, when the metal was first imported to England from India.

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ZINC alloyed with copper forms brass. It is known that the ancient Greeks and Romans knew of brass, which they called cadmia, not only because such men as Dioscorides, Strabo and Pliny, wrote about it, but also because analyses of ancient brasses show them to contain from 6 to 17 per cent of zinc. This brass was made by heating zinc ore with copper, since, apparently, the ancients were not familiar with zinc as a metal. When the brass made by this process was poured off, there was always a dross, or residue, left in the pot. Along in the first quarter of the 16th century, Erasmus Ebenezer, a German, discovered that this dross could also be used with copper to make brass.

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HOWEVER, Albertus Magnus, or Bolstadt, as he was more commonly known, who died in 1280, is the first writer who makes express mention of zinc, although Theophrastus Paracelsus, writing in 1530 is the first who characterizes zinc as a distinct metal. The ore of which Magnus wrote, came from Goslar, that of Paracelsus from Corinthia.

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AT that time, it was difficult to obtain much knowledge of either zinc, or its ores, due to the fact that zinc was prized as an alchemic substance, that is, it was thought to have the power of transmuting copper into a precious metal.

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THE first certain account of zinc production (at Goslar) is given by Van Lohneiss in 1617, who states: "When the people at the melting house are employed in melting, there is formed under the furnace, in the crevices of the walls, under the stones where it is not plastered, a metal which is called "zinc," and when the walls are scraped falls down in a trough to receive it. This metal has a great resemblance to tin, but is harder and less malleable and rings like a small bell. It is not much valued and the servants and workmen collect it only when promised drink money. They, however, scrape off more of it at one time than another; for sometimes they collect two pounds and at other times two ounces. The metal by itself is of no use, as, like bismuth it is not malleable, but when mixed with tin renders the latter harder and more beautiful, like English tin. This zinc is in great request among the alchemists."

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IN 1742, Von Swab, a Swede, succeeded in obtaining zinc from the ore, calamine, by distillation, although an Englishman, Dr. Lawson is said to have done the same thing a year, or so, previously. The latter is said to have travelled in China and learned the method of the Chinese for producing zinc.

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MARGGRAF, almost contemporary, and not aware of the previous discoveries, set the method of winning zinc beyond all doubt, and published the results of his discovery in the Mem de l'acad de Berlin, in 1746. Swab obtained his zinc from pseudo-galena, and Marggraf and Lawson obtained their zinc from calamine.

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THE manufacture of zinc in England, on a commercial scale, was begun in 1743, at Bristol although Jungius mentions the importation of zinc to England in 1647 from India. About 200 tons were made, annually, at Mr Champion's works. In 1775 a second works was built by James Emerson, who had been in charge of Champion's works. These two men, Champion and Emerson, are said to have learned their art from Dr. Lawson. With the exception of mechanical improvements and better methods of heat application, the zinc distillation process is essentially the same today as it was at that time.

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THE first zinc produced in America was made in 1838 by the government, but was not a distinct industry until just prior to the Civil War.

The First Hot Galvanizing Process

ABOUT the same time that Mr. Champion began the manufacture of zinc in England, Meloun developed the first known galvanizing process. The essential features of his process are the same used today for hot galvanizng. Meloun first cleaned the object to be coated in an acid bath composed of diluted sulfuric acid, diluted muriatic acid, or a mixture of equal amounts of the two acids and water. The object was then washed, and scrubbed with sand or emery powder. It was then dipped in sal ammoniac, followed by immersion in molten zinc. It was recommended that the zinc bath be covered with a fatty material.

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JUST how the process of zinc coating came to be called galvanizing is not clear, but I believe the term was first used by Sir. Humphrey Davey in connection with his experiments on the electro-chemical theory of corrosion, his theory being that the zinc protected iron and steel against corrosion by "galvanic" action.

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ALTHOUGH the hot dip galvanizing process was well understood in France in the early part of the 19th century and the art introduced into the United States from France a short time later, it rapidly fell into disrepute, due, probably, to the carelessness of the early galvanizers. About this same time (Jour. Frank. Inst. 1839) the use of a refractory lined pot for molten spelter was described, as well as the process for floating zinc on lead. The use of the centrifuge in the nail galvanizing process, and the heating of the galvanizing pot above the dross line were also made known.

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EVEN as late as the early fifties, Ure, an authority on metallurgy thus described galvanizing: "—somewhat fantastic name given to iron tinned by a peculiar patent process whereby it resists the rusting influence of damp air and even moisture much longer than ordinary tin plate. The following is the prescribed process: Clean the surface of the iron perfectly by the joint action of acid and friction. Plunge it into a bath of melted zinc covered with sal ammoniac, and stir it about until it becomes superficially alloyed with this metal. When the metal prepared thus is exposed to humidity the zinc is said to oxidize slowly by galvanic action and so protect the iron from rusting within it, whereby the outer surface remains for a long period perfectly white, in circumstances under which iron tinned in the usual way would have superficially browned with rust."

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Invention of the Continuous Process

IN 1860, the continuous process for galvanizing wire was invented by Bedson. Prior to this time the drawn wire was annealed in pots. The soft wire was cleaned in dilute sulfuric acid and placed wet on the reels. Following this, the wire was drawn through a bath of dilute muriatic acid, and then through the molten zinc. The coated wire was smoothed by means of a sand wipe. The zinc thickness was about .0015 inch for an approximately No. 8 gauge wire.

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THIS process was very troublesome and not easily controlled. For example, if the wire remained on the reels too long it corroded badly and would not coat uniformly, if at all. Many times the wire would be dirty and would not coat "and many other sources of trouble, all of which tended to obtain the notoriety that all galvanized wire was exceedingly rotten and brittle owing to the process it went through." (Bedson, Jour. Br. Ir. & St. Inst. 1893).

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Hot Galvanizing Process in 1905

CUSHMAN (Farmers Bulletin No. 239—U. S. Dept. Agr. 1905) described the wire galvanizing process in use at that time. He says in substance:

"In the first place, the word "galvanizing" as used gives a wrong impression. It is possible to dissolve zinc in an acid and then by means of a galvanic current, by the very principles of electrolysis properly controlled, to deposit it as a coating upon another metal like iron. It has been shown that this method will give the most adhesive coating of zinc upon iron that it is possible to obtain.

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THE wire for galvanizing, is run through brick tubes, or ovens, which are heated by coal or gas, where the process of annealing or softening takes place. When the wire is cool enough it enters a bath of acid, which cleans it and removes any scales which may have formed during the process of annealing. This so-called "pickle" consists of diluted muratic acid and is a necessary treatment, as the wire would not take the zinc unless it had first been through the acid bath. The question as to whether the acid should be washed from the wire before it enters the zinc bath is important and manufacturers seem to differ in their practice. It is by no means certain that acid included in the zinc and under it will not tend to corrode the metal rapidly. Some sort of chloride is undoubtedly necessary to make the iron take the zinc, but it is natural to suppose that the presence of actual acid should be avoided.

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THE wire is next run into a vessel about 16 feet long containing melted zinc. As the wire emerges from the zinc bath it is run through asbestos wipers which wipe off nearly all of the zinc and leave a smooth coating, which usually amounts to 1 to 1½ per cent of the wire."

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WHEN telegraph wire is made, the wire is drawn much more slowly through the zinc bath, and does not pass through asbestos wipers, but it smoothed by passing through a shallow bed of slightly damp charcoal powder.

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Hot Galvanizing Process in 1909

IN 1909 Sang (Transactions of the American Electrochemical Society) stated that the usual process for galvanizing wire at that time was as follows: The wire was first annealed and then cleaned by passing thru a bath of hydrochloric acid. It was then fluxed, (probably by means of zinc chloride) and then passed into the molten zinc, held at a temperature of 500° C. (932° F.) The wire, after leaving the zinc bath, was wiped by means of asbestos (screw) wipes. Sang

states that the drawbacks to the process were:

(1) Imperfect annealing.

(2) Absorption of hydrogen from the acid bath, promotion of subsequent corrosion; and prevention of a good zinc-iron union.

(3) Fluxing causes pockets to form between the zinc and the iron in which traces of chloride are imprisoned and assists corrosion; the wiping destroys the pockets themselves leaving the coating non adherent in spots.

(4) The zinc deposited is higher in iron and therefore more easily scaled off than pure zinc and sooner destroyed by air and other agencies. (The high iron content was probably due to the high temperature of the zinc bath.)

(5) The wiping is difficult to control; if too close it will cause streakiness, and if wiped too cold, transverse cracks appear.

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ALTHOUGH, fundamentally, the wire galvanizing process has remained the same since it was first described by Bedson in 1860, improvements in technique and structure have been made. Among these, are better steel for annealing pots and spelter pans; the use of molten lead for annealing in place of the open tubes which scaled the wire badly; and, of course, the improved methods of firing and temperature control.

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Methods of Cleaning Before Galvanizing

THERE have been a number of methods proposed for cleaning the wire prior to galvanizing, but most wire galvanizers still continue to use the hydrochloric acid cleaning bath. The fluxing of the wire by the use of zinc chloride, ammonium chloride (sal ammoniac) or zinc ammonium chloride is substantially the same as it always has been. Deeper pots have been used for the molten zinc allowing for better temperature control; and the firing has been carried out above the dross line, a method recommended over 100 years ago. Pots up to 32 feet in length have been used for wire galvanizing.

THE asbestos wipes such as are used at the present time were invented about 1881. These wipes are either of the hard or soft type. The pressure applied to the asbestos for wiping is either of the screw or lever type. Many kinds of wipers have been used for wire, such, for example, as sand, charcoal and loose asbestos fibre. Other materials have also been recommended during the last 50 to 60 years for wiping wire, but none of these have survived except the asbestos wipe and the charcoal wipe, the latter being used principally for telephone and telegraph wire, and similar products where a more heavy coating was desired than could be produced by the use of asbestos wipes.

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Recent Developments in the Hot Galvanizing Process

THERE have been at least three modifications of the hot galvanizing process developed during the past 15 years, designed principally to provide heavier coatings which would withstand deformation without injury. In the order of their introduction, these processes are:

(1) Galvannealing process

(2) Crapo process

(3) Flame Sealed process

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The Galvannealing Process

THE galvannealing process, which was patented in 1922, uses no wipes. The coated wire, as it leaves the bath of molten zinc, is passed over a skimming device designed to prevent the carrying over of zinc skimmings and other foreign material, and, then, before the coating has set, the coated wire is passed into a long heat treating furnace carried at a temperature suitable to smoothen and malleabilize the zinc coating. The temperature of the heat-treating furnace varies with the gauge of the coated wire and the speed at which the wire is traveling, but, at all times, it is above the melting point of the zinc.

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The Crapo Process

THE Crapo process was developed shortly after the galvannealing process and consists substantially in passing the wire thru a bath of a molten salt mixture capable of causing a surface carburization of the wire prior to coating.

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The Flame Seal Process

A SHORT time later the Flame Seal process was developed. With this process, the wire, as it leaves the coating bath, passes thru a mechanical device for regulating the weight of coating, after which, and before the coating has set, it is subjected to the action of controlled flame for the purpose of evening, smoothing and malleabilizing the coating.

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Other Processes

THERE have been many processes advanced for galvanizing wire since 1742 but none of these have proved practical except those noted. A typical example of a proposed process for galvanizing wire, which did not prove to be practical, is that described by Sang in Transaction of the American Electrochemical Society for 1909 and 1911. His process consisted in passing wire thru a furnace containing a mixture of crushed coal and zinc oxide and heating the wire electrically by means of an alternating current By this means the zinc oxide was reduced and deposited on the iron. The heat removed the grease and the carbon of the coal reduced the scale, the high temperature used accomplishing the annealing. A coating was formed comprising an alloy of zinc and iron, similar to that produced by Sherardizing.

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SANG stated that the cleaning and annealing complicated the process. He used 154 kilowatt hours per long ton of wire of any diameter. The speeds which he used averaged about 35 R.P.M. although he stated that he had used as high as 850 R.P.M. No wipes were necessary. The wire was cooled after coating by passing it thru sand which also brightened and polished the coating. Sang stated that working with zinc dust above 420° C. (788° F.) the galvanizing is instantaneous the minute the wire reaches the tempera-

(*Please turn to page 403*)

Outstanding Personalities of the Wire Industry

J. R. LONGWELL
Chief Engineer, Carboloy Company, Inc.

Carboloy Announces Changes and Additions to Staff

CARBOLOY Company, Inc., Detroit, Michigan, manufacturers of Carboloy cemented carbide tools, dies and wheel dressers, recently announced the following changes in, and additions to, the personnel of their organization:

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P. R. Mallory, former Chairman of the Board, has resigned. He is succeeded by **Dr. Zay Jeffries,** former President. **W. G. Robbins** and **E. S. Morrison** have been elected to the Board of Directors.

✦ ✦ ✦

W. G. **Robbins,** former Vice President and General Sales Manager, has been elected President. **A. MacKenzie,** former Manager of Manufacturing, has been elected Vice President in charge of manufacturing. **K. R. Beardslee,** former Pittsburgh District Sales Manager, has been appointed General Sales Manager of the Carboloy Company. **J. R. Longwell,** former Die Engineer, has been appointed Chief Engineer. **A. A. Merry,** former Cleveland District Sales Manager, has been appointed Special Representative in charge of activities with agents licensed to supply Carboloy on their tools, dies and machines.

W. G. ROBBINS
President, Carboloy Company, Inc.

A. H. **Godfrey,** former Cleveland representative, has been appointed Cleveland District Manager. **P. W. Weiser,** former Pittsburgh representative, has been appointed District Manager of the Pittsburgh District.

✦ ✦ ✦

THE following sales representatives have been added to the various District Offices: Detroit—W. A. Schofield. Newark—G. G. DeWitt. Philadelphia—L. J. Martin. Pittsburgh — A. Jamieson. Cleveland—G. M. Mencke.

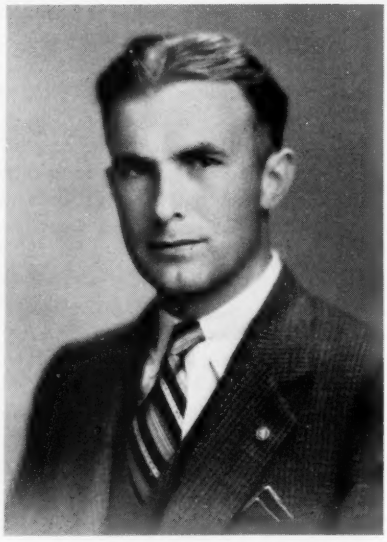
✦ ✦ ✦

H. L. Quinn has been added to the Engineering Staff.

✦ ✦ ✦

F. L. Riggin Elected President of Mueller Brass Company

FRED L. RIGGIN has been elected president of Mueller Brass Company, Port Huron, Mich., to succeed O. B. Mueller who resigned recently. Mr. Riggin has been associated with Mr. Mueller for many years having started with the original Mueller Company in Decatur, Ill., 32 years ago.



K. R. BEARDSLEE
General Sales Manager, Carboloy Company, Inc.

IN 1917 when the present company was established at Port Huron, Mr. Riggin became director of sales and some time ago was chosen executive vice president of the company.

✦ ✦ ✦

G. P. Fryer Now Associated With R. H. Miller Co.

MR. **Randolph V. Miller,** President of the R. H. Miller Co., of Homer, N. Y., manufacturers of STEELSKIN Wire Drawing Powders, announces the association with his company of **Mr. G. P. Fryer,** formerly Production Vice-President of The J. T. Robertson Co., Syracuse, N. Y., makers of Robertson's Wire Drawing Soaps.

✦ ✦ ✦

MR. Fryer has had a long and practical experience in the development and production of Wire Drawing Soaps and Lubricants and his association with the STEELSKIN organization now makes it possible for this company to cover the entire field of Lubricants for the Industry.

✦ ✦ ✦

G. D. Hartley Announces Retirement

GEORGE D. HARTLEY announces his withdrawal from Sleeper & Hartley, Inc., Worcester,

(*Please turn to page 393*)

A Review of Recent Wire Patents

No. 2,042,520, APPARATUS FOR FEEDING WIRES FOR ELECTRIC LAMPS AND SIMILAR DEVICES, Patented June 2, 1936 by John Flaws, Jr., Cleveland Heights, and August W. Seitz, Euclid, Ohio, assignors to General Electric Company, a corporation of New York.

In the operation of this apparatus, one wire is fed at a time and the apparatus is not affected by knot-like welds or other surface conditions of the wires.

✦ ✦ ✦

No. 2,042,647, SPRING DEVICE, Patented June 2, 1936 by William E. Wine, Toledo, Ohio.

This spring device is adapted for association with the side frames of railway car trucks to support the bolsters. A friction producing means is provided which is engageable with the spring for substantially their entire length and does not project beyond the ends of the spring.

✦ ✦ ✦

No. 2,043,044, ELECTRIC CABLE, Patented June 2, 1936 by Homer G. Knoderer, Fairfield, Conn., assignor to General Electric Company, a corporation of New York.

The assembly includes an insulated wire and an uninsulated wire arranged side by side with an armor therefor comprising a metal strip folded over both wires so as to conform to the peripheral surfaces thereof and in electrical contact with one of them, the open edges of the strip adjacent each other and the strip being provided with corrugations in a direction crosswise of the strip's length.

✦ ✦ ✦

No. 2,043,130, METHOD OF MANUFACTURING STRANDED CONDUCTORS, Patented June 2, 1936 by Carl Traugott, Oldenburg, Germany, assignor to Norddeutsche Seekabelwerke Aktiengesellschaft, Nordenham, Germany.

This method is adapted for manufacturing stranded electric conductors of the re-entrant type comprising a number of individual insulated wires in a stranding machine having bobbins which pay out the individual wires.

✦ ✦ ✦

No. 2,043,208, MOTOR CONTROL SYSTEM FOR COILING MECHANISMS, Patented June 2, 1936 by Donald I. Bohn, Pittsburgh, Pa., assignor to Aluminum Company of America, Pittsburgh, Pa., a corporation of Pennsylvania.

An electrical control system is provided for wire coiling machines capable of producing constant tension on the material delivered.

✦ ✦ ✦

Reissue No. 20,000, APPARATUS AND PROCESS FOR UNCOILING COILED SHEET METAL, Patented June 9, 1936 by William H. Hofer, Middletown, Ohio, assignor to The American Rolling Mill Company, Middletown, Ohio, a corporation of Ohio.

The method is particularly adapted for decoiling metal stock which is subject to coiler breaks and comprises withdrawing the metal from a coil in a tangential direction by engaging the metal close to the coil and rotating the coil in timed relationship with this withdrawal. The position of the coil is maintained with respect to the position of engagement during this withdrawal so as to prevent sharp bending of the metal.

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 17 East 42nd St., New York.

✦ ✦ ✦

No. 2,043,400, CONDUCTOR CABLE, Patented June 9, 1936 by Walter T. Wells, Los Angeles, Calif., assignor to The Technicraft Engineering Corporation, Los Angeles, Calif., a corporation of Calif.

In this construction, there is a central conductor surrounded by a coating of dielectric material, laminations of woven fabric surrounding this conductor and a layer of malleable, moisture-proof material surrounding the fabric and completely filling the voids therein. Surrounding the entire structure is an outer lay composed of a number of stranded wires.

✦ ✦ ✦

No. 2,043,401, SUPPORTING AND CONDUCTING CABLE AND METHOD OF CONSTRUCTING THE SAME, Patented June 9, 1936 by Walter T. Wells, Glendale, Calif., assignor to The Technicraft Engineering Corporation, Los Angeles, Calif., a corporation of Calif.

This patent covers the method of constructing the conductor cable covered in U. S. patent 2,043,400.

✦ ✦ ✦

No. 2,043,528, WIRE INSULATION TESTING APPARATUS AND METHOD, Patented June 9, 1936 by Ralph L. Davis, Wallingford, Conn.

A testing electrode is provided which is spaced from the wire conductor only by the insulation. As the wire is wound on a take-on roll it passes by the electrode. Means connected to the testing electrode operates to indicate the insulation resistance to successive sections of the insulation.

✦ ✦ ✦

No. 2,043,702, INSULATED WIRE, Patented June 9, 1936 by William J. Homer, Hinsdale, Ill., assignor, by mesne assignments, to Associated Electric Laboratories, Inc., Chicago, Ill., a corporation of Delaware.

A coating of enamel is applied to the wire, then multi-thread strands of cellulose material are wrapped in layers over the enamel and treated with a solvent of this material to thereby amalgamate the material into a homogeneous mass and cause it to adhere to the enamel.

✦ ✦ ✦

No. 2,044,336, WIRE FABRIC FOR BEDSPRINGS AND OTHER ARTICLES, Patented June 16, 1936 by Jacob Schwartzman, Brooklyn, N. Y.

Wire is bent back and forth in alternate directions to form a zig-zag, the bends of one side of the wire being engaged by one hook end of a U-shaped link while the bends on the other side of the wire are engaged by closed ends upon the other leg of the U-shaped link.

✦ ✦ ✦

No. 2,044,484, HIGH SPEED WIRE DRAWING MACHINE, Patented June 16, 1936 by William D. Pierson and George W. Jackman, Waterbury, Conn., assignors to The Waterbury Farrel Foundry & Machine Company, Waterbury, Conn., a corporation of Conn.

Included in the construction is a cabinet having a multi-socket selective stepped die box attached to the entrance wall thereof and a pair of stepped wire drawing cones journaled in the rear wall of the cabinet. A multiple die holder is located between the cones. The entrance and exit walls of the cabinet are provided with slots formed in the front edges thereof, whereby the wire to be drawn having a number of dies strung thereupon may be passed into the cabinet from the front and the dies assembled therein.

✦ ✦ ✦

No. 2,044,574, STRIPPER FOR WIRE-RECEIVING BLOCKS, Patented June 16, 1936 by Charles D. Johnson, Worcester, Mass., assignor to Johnson Steel & Wire Company, Inc., Worcester, Mass., a corporation of Mass.

A rotary block, having a die-receiving surface is provided on which the wire is wound. In order to lift the wire load accumulating above the wire-receiving surface and separate it bodily therefrom, a device is included in the construction operating independently of the rotative movement of the block and while the latter is at rest or rotating.

✦ ✦ ✦

No. 2,044,740, NAIL AND METHOD OF MAKING SAME, Patented June 16, 1936 by Harry S. Stronach, Oak Park, Ill., assignor to Strowan Corporation, Oak Park, Ill., a corporation of Delaware.

The construction includes a reduced entering face having an area equal to a substantial portion of the cross sectional area of the nail body, and sloping surfaces joining the body and entering face, the entering face being roughened and cupped in formation.

✦ ✦ ✦

No. 2,044,970, METHOD OF COATING INSULATED WIRE OR THE LIKE, Patented June 23, 1936 by Albert T. Candy, Jr., Oak Park, Ill.

The fabric jacket surrounding the wire is impregnated with a flame-repellent pitch at a temperature above the melting point of the pitch and then, while the coated wire is still hot, it is passed through a powdered mixture of the pigment and binder fusible below the temperature of the hot wire, thereby forming a layer of this pigment mixture over the jacket.

✦ ✦ ✦

No. 2,044,986, METAL-EXTRUDING DIE, Patented June 23, 1936 by William

(*Please turn to page 395*)

Exports and Imports of Wire

Exports of Iron and Steel Wire Products in May, 1936 and May, 1935
(In gross tons)

	May 1936	April 1936	May 1935
Wire rods	3,183	4,664	1,150
Hoops, bands and strip steel	4,169	5,289	3,508
Plain black or galvanized iron or steel wire	4,772	3,288	3,055
Barbed wire and woven wire fencing	3,395	3,204	2,122
Woven wire screen cloth	79	100	83
Wire rope	283	370	296
Insulated iron or steel wire and cable—see analysis below			
Other wire and manufactures	326	367	364
Wire nails	786	850	688
Tacks	24	24	29
Other nails, including staples	242	288	212
Bolts, machine screws, nuts, rivets and washers	621	561	595
Total, these 11 classifications	17,880	19,005	12,102

Imports of Iron and Steel Wire Into the United States
(In gross tons)

Concrete reinforcement bars	682	202	190
Hollow bars and drill steel	192	185	92
Wire rods	1,690	1,597	1,750
Barbed wire	1,069	1,439	1,900
Round iron and steel wire	480	233	388
Telephone and telegraph wire	.....	5	6
Flat wire and strip steel	261	259	134
Wire rope and strand	163	257	98
Other wire	85	138	57
Hoops and bands	2,373	2,690	4,750
Nails, tacks and staples	1,595	2,337	1,441
Bolts, nuts and rivets	80	36	37
Total, these 12 classifications	8,670	9,378	10,843

Exports of Insulated Wire and Cable, May, 1936

	Foreign		To U. S. Possessions	
	Pounds	Dollars	Pounds	Dollars
Insulated iron or steel wire and cable	15,614	$ 2,748	2,234	$ 289
Rubber-covered wire	515,862	111,383	86,455	18,329
Copper weatherproof wire	193,210	33,965	549,146	8,425
Copper telephone cable	17,505	5,299	3,678	885
Other insulated copper wire	357,521	82,198	144,910	12,159
Nickel-chrome electric resistance wire	23,340	30,783	22	15
Total, these 6 classifications	1,123,052	$266,376	286,445	$40,102

Exports

EXPORTS of iron and steel products (excepting scrap) from the United States during May aggregated 97,511 gross tons valued at $7,388,962, thereby recording declines of 7.2 percent in both quantity and value when compared with the April trade. These totals were, however, sharply ahead (48.5 percent in quantity and 60 per cent in value) of those for the corresponding month of 1935. Shipments during the initial 5-month period of the current year—450,878 tons valued at $33,-869,431—were maintained at a considerably higher level (20,6. percent in quantity and 28 percent in value) than those which went forward to foreign outlets in the first five months of last year.

Tin Plate Shipments Maintained at High Level

TIN plate continued to be the leading iron and steel product exported during the month (excluding scrap), the total of 25,889 tons finding numerous outlets of which the chief ones were Japan (2,867), China (2,433), Canada (2,329), Argentina (1,669), British Malaya (1,650), and the Netherlands (1,489). Although a lower trade resulted in black steel sheets, that product continued to be shipped to a large total (10,106 tons) and found widespread markets in which Canada (3,369), Soviet Russia (2,444), Mexico (1,026), Australia (759), and Brazil (630) were outstanding. Next came 'other plate' with an aggregate of 5,207 tons going chiefly to Mozambique (2,278), Canada (927), the Philippine Islands (439), Mexico (341), and Cuba (203). The fourth item of importance—skelp—was shipped to a total of 5,188 tons, with Canada taking practically all (5,158). 'Other steel bars' followed, its total of 5,114 tons finding outlet for the most part in Canada (1,802), the Philippine Islands (1,002), Panama (602), and Peru (431). Galvanized steel sheets also found wide distribution in a trade aggregating 4,830 tons, the outstanding markets being the Philippine Islands (1,743), Brazil (551), Colombia (511) Cuba (440), and Venezuela (246).

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Canada Again Leading Individual Market

SHIPMENTS totaling 21,759 tons were destined to Canada, thus allowing that market to maintain its role as the leading outlet for United States iron and steel products (excepting scrap). Its May purchases for the most part—while taking in numerous items—were mostly of skelp (5,158), black steel sheets (3,369), cold rolled strip steel (2,329), plain shapes (1,895), 'other steel bars' (1,802), and hot rolled strip steel (1,780). Sales to the Philippine Islands (6,-840 tons) followed and were mainly of galvanized steel sheets (1,743), tin plate (1,141), 'other steel bars' (1,002), heavy rails (451), rail joints, splice bars, etc., (447), and 'other plate' (439). Brazil—the third market—purchased 6,015 tons of iron and steel products from the United States, the predominant items being light rails (1,585), tin plant (1,303), plain wire (664), black steel sheets (630), barbed wire (552), and galvanzed steel sheets (551). Japan was next and in its total of 5,874 tons the chief products were tin plate (2,867), wire rods (1,224), ingots, blooms, etc., (816), and 'other steel bars' (262). Mexico's trade amounted to 5,065 tons, with the outstanding items being black steel sheets (1,026), tin plate (988), barbed wire (542), 'other plate' (341), galvanized steel sheets (233), and car wheels and axles (228). Cuba's trade of 4,550 tons was mostly of heavy rails

(998), tin plate (689), barbed wire (573), galvanized steel sheets (440), plain shapes (253), and 'other plate' (203)

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Import Trend Slightly Upward in May

IRON and steel imports during May (excepting scrap) followed a slightly upward curve and aggregated 43,696 tons valued at $1,766,599, thereby registering gains of 7.2 percent and 4.1 percent respectively, when compared with April receipts. It is to be noted that while imports during the initial 5-month period of the current year (212,723) tons valued at $8,406,415) registered a quantity gain of 52 percent, only a 36 percent advance resulted in a value comparison.

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Pig Iron Continues As Leading Import Item

PIG iron was imported to a total 15,296 tons, and remained the leading import product on a tonnage basis, the chief suppliers being the Netherlands (5,913), British India (4,361) Canada (2,911), and Soviet Russia (1,145). Next came structural shapes (4,936 tons), practically all coming from Belgium (3,481), and France (1,321) Spiegeleisen—the third item of importance—was all received from Canada (4,579 tons). Imports of bars, whether solid or hollow, amounted to 3,805 tons, and were sent in principally by Belgium (2,496), France (534), Sweden (357), and Germany (344). Next was ferro-manganese (2,623 tons), purchased chiefly from Norway (1,712), Czechoslovakia (400), and the Netherlands (393). 'Other hoops' (2,373 tons) made up the sixth product and came mostly from Belgium (1,723), France (408), and Germany (217).

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Where May Imports Came From

BELGIUM continued to lead in the supply of iron and steel products (excluding scrap) to the United States during May sending in 9,194 tons made up chiefly of shapes (3,481), bars, whether solid or hollow (2,496), 'other hoops' (1,723), and concrete reinforcing bars (682). Canada was next with a trade totaling 8,863 tons made up mostly of spiegeleisen (4,589), and pig iron (2,911). Germany's rather varied trade of 7,021 tons followed, the outstanding items being nails, tacks, and staples (1,515), barbed wire (1,058), sheets, skelp, and sawplate (998), wire rods (881), pig iron (666), and 'other pipe' (508). British India's share (4,361 tons), was all of pig iron, while the next supplier—France—accounted for 2,493 tons in which shapes (1,321), bars, whether solid or hollow (534), and 'other hoops' (408) were the principal products.

✦ ✦ ✦

RECEIPTS of **card clothing** (37,104 square feet valued at $50,971), registered gains of 44 percent and 50 percent, when compared with April, and came from the United Kingdom (33,864 square feet valued at $46,586),

(*Please turn to page 398*)

MICROMETER PRECISION MICRO-WELD TRADE MARK REG. U. S. PAT. OFF.

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MICRO-WELDERS with dial indicating annealing attachments are now available for high carbon wire.

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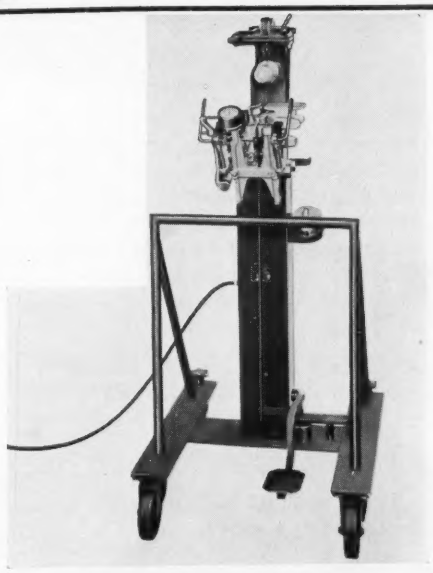

MICRO PRODUCTS COMPANY
20 NORTH WACKER DRIVE, CHICAGO, ILL.
Telephone State 7468 General Office and Factory, Peoria, Ills.

'Round the World With the Wire Industry

German Notes

IT is of interest that the French wire producers, who were selling for export through the medium of German exporters (Hamburg and Bremen) have discontinued their export sales. The recent heavy burdens due to compulsory increase of wages, combined with a reduction of working hours to a 40 hour week, payment of all time lost on strike, and twelve days vacation a year with pay has left the industry unable to sell at present for export without a sharp increase of prices, which, of course, is quite impossible.

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THE recent advance of prices for wire products in Great Britain will open this market to those outside of the IWECO. The IWECO members are getting for the British market a certain annual allotment, which of course does not include outsiders. The IWECO reports that the general trend on the export market is showing signs of considerable improvement. Business in May had been quiet, but the demand in June showed a material improvement in almost all markets. This concerns particularly South Africa, some of the Latin American markets, the Balkans, Egypt, and Scandinavia. The Japanese wire competition is rather keen, but the export restrictions on wire nails from Japan are still maintained. Canada, after a very satisfactory start in wire nail exports to England and Ireland, has almost completely withdrawn from that market. Prices for all products are unaltered. On the domestic German market, turnovers this year were 30% better than last year, and the industry is operating at approximately 74% of capacity.

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RUSSIA is starting the production of wire nail machinery and is copying a few well known German types for this purpose, in spite of the protest of the German works. The quality of the Russian-made products, however, has not yet improved in the metal machinery field, and it is significant that an aeroplane motor does not stand more than 200 flying hours (statement by "Trud").

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EXPORTS of German wire making machines show a constant improvement. During the first four months of this year, the value was M 2,183,400, compared with 1,682,300 last year, and 911,380 two years ago. Exports of bolts and rivets, screws and washers show a very sharp increase. Total exports were 6,883 tons the first four months in 1934, 13,558 tons same time in 1935, and 17,922 tons this year. Fish bolts are not included.

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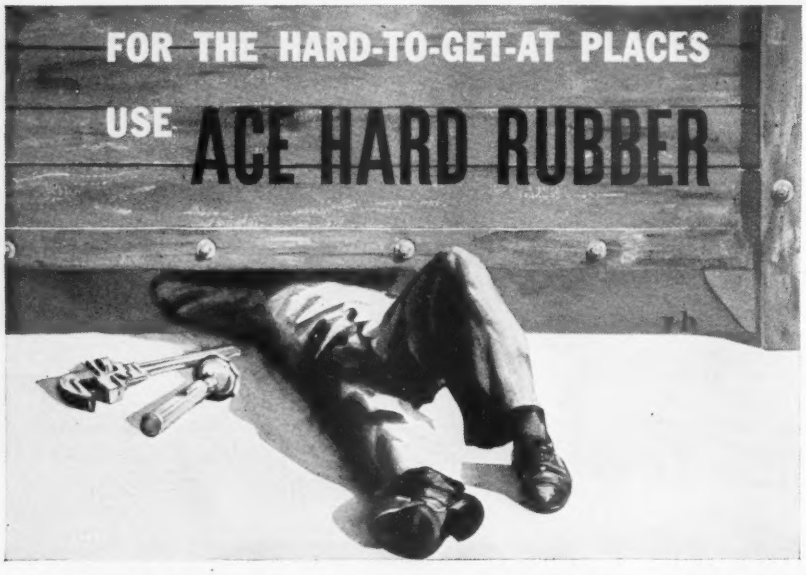
ORDERS for wire products from the United States have undergone an interesting change. It was anticipated that due to advance of prices for bright and other manufactured wire, galvanized wire, etc., and reduction of prices for finished wire products in the United States, many small makers



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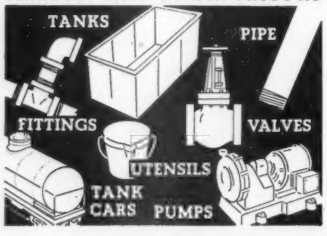

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'Round the World With the Wire Industry

would import wire for manufacturing purposes. This has already happened and the quantity of wire for this purpose sold to the United States has nearly trebled since March, whereas orders for nails, barbed wire and wire netting have been falling off. Particularly wire nail wire and mattress wire (tinned) are in good demand, and a further increase of business for these products is anticipated.

✦ ✦ ✦

California Wire Cloth Company Establishes New Office and Warehouse

NEW offices and warehouse facilities have been established in San Francisco by the California Wire Cloth Company, of Oakland, California. This company, widely known by its unique Grizzly Bear and "Calwico" trade mark is a real pioneer in Pacific Coast industry, having been in existence since 1859.

✦ ✦ ✦

THE company operates one of the most up-to-the-minute wire-cloth plants found anywhere in the United States. Every phase of production from the actual drawing of the wire to the final weaving is maintained. All standard or special screens are available—stock materials include iron, steel, brass, copper, bronze, monel-metal, aluminum and stainless steel.

✦ ✦ ✦

COMPLETE engineering facilities are available for the designing and developing of screens and wire cloths to meet practically all requirements of almost every industry.

✦ ✦ ✦

"Armco" Buys Interest in Rustless Iron & Steel Corporation

AMERICAN Rolling Mill Company has purchased a stock interest in Rustless Iron & Steel Corporation. "Armco" has been the largest individual customer of the Rustless corporation.

✦ ✦ ✦

THE Rustless Iron Company of America was incorporated February 24th, 1926 in Maryland. C. E. Tuttle is chairman; W. S. Symington, president; T. F. McLaughlin, vice president; J. K. Remsen, secretary; W. C. Miller, treasurer and W. F. Marks, purchasing agent.

✦ ✦ ✦

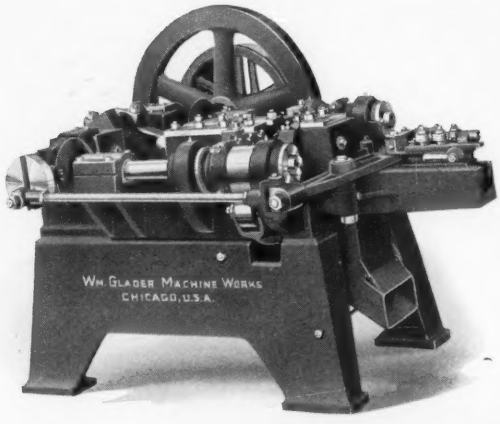
IT is understood that the initial advantage of the purchase will be to permit the research organizations of the two companies to work out important developments which have been decided upon.

Czechoslovak Wire Netting Cartel

THREE Czechoslovak manufacturers of wire netting concluded a cartel agreement regulating production and sales of wire netting on January 1, 1935, and in view of its favorable effect it has been supplemented by a new one and additional members have adhered thereto, we are informed by

GLADER

HIGH SPEED WIRE NAIL MACHINE



Machines are built in nine sizes to cover a range of nails from 15 gauge 1/4" long to 3/8" diameter 12" long, including large head roofing nails.

A month's operation of one of our latest type machines will produce an average of more than 200 pounds of 8d common nails per hour.

These machines are well liked by operators, due to the fact that adjustments are easily made and can, in most instances, be made while the machine is in operation.

The performance of these machines, both as to production and low maintenance cost has led to their exclusive selection in all of the recent major nail making machine installations.

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'Round the World With the Wire Industry

Dr. A. Broft, office of the commercial attache, Prague. The cartel operates through the "Prodejni Spolecnost pro Retezy a Dratene Zbozi" (Sales Company for Chains and Wire Products), Lazarska 7, Prague II.

✦ ✦ ✦

Manufacture of Steel Wire in South Africa

ANOTHER company will undertake the manufacture of steel wire and steel rope for mining and other purposes in the Union of South Africa, we are informed by Commercial Attache Samuel H. Day, Johannesburg. The factory will be situated near the center of the Witwatersrand and will be equipped with a modern plant for wire drawing and rope making. Insofar as they are suitable for the finished products in question, it is proposed to utilize local steel products in the manufacture of the steel rope.

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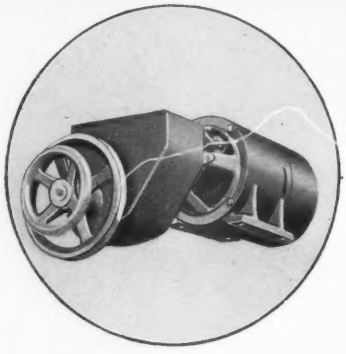
Broken Hill Proprietary Company in Control of Australian Iron and Steel Limited

CONTROL of the **Australian** Iron and Steel, Limited, was acquired by the Broken Hill Proprietary Company in October, 1935, and it is expected that this merger will materially improve the prospects of both in that local competition, etc., will be eliminated, we are informed by Trade Commissioner in Charge E. C. Squire, Sydney. In April 1936 the sheet mills of the Australian Iron and Steel, Limited, at Port Kembla were sold to Lysaght's Newcastle Works, Limited, which is controlled by the Broken Hill Proprietary Company and is Australia's main producer of galvanized iron. The mill acquired is reported to have a capacity of between 20,000 and 30,000 tons a year and was completed in 1935, however, it is understood that production has been intermittent because of technical difficulties. The Broken Hill Proprietary Company now has to all intents and purposes complete control of the Australian industry.

Syncro Insulating Machines



SYNCRO Flyers and Capstans are individually driven by direct connected synchronized motors. This insures a smooth constant drive and eliminates mechanical back-lashes and vibrations which are encountered in conventional drives.

A production efficiency of 75% and greater is maintained at high speeds with this type of drive when serving cellulose films and 1 mil insulating papers.

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Outstanding Personalities of the Wire Industry

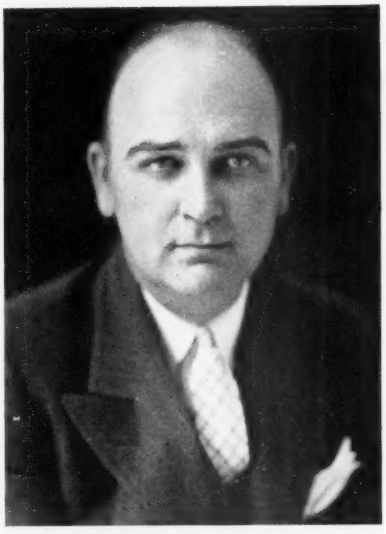
(*Continued from page 386*)

Mass., as he has recently sold his entire stock holdings in that company to his former associates. An announcement of his future plans will be made shortly.

✦ ✦ ✦

H. W. Reynolds, Boston District Manager, Wheeling Steel Corp.

WHEELING Steel announces the appointment of **Howard W. Reynolds** as district manager in charge of the Boston office, succeeding S. H. Waters, who has been transferred to the New York office. Mr. Reynolds, who has been with Wheeling for a number of years moves east from Milwaukee, where he resided while engaged in sales work throughout the state of Wisconsin for the Chicago office of Wheeling Steel Corporation.



H. W. REYNOLDS
Boston District Manager, Wheeling Steel Corp.

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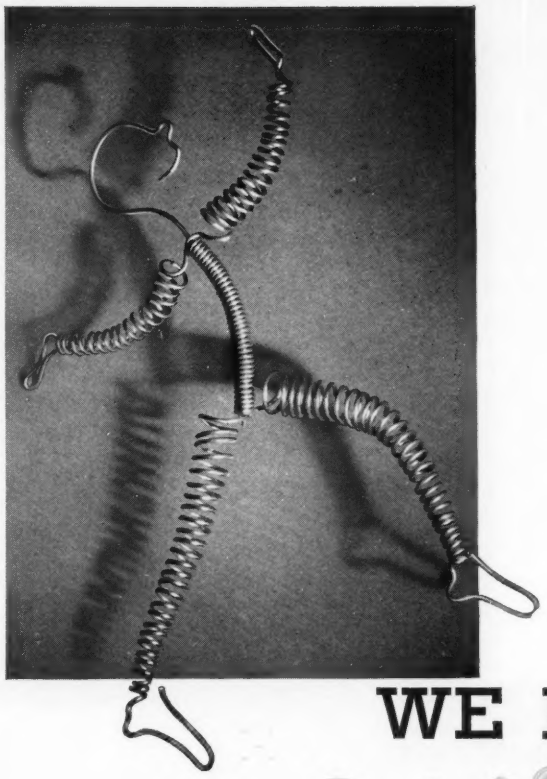

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TENTATIVE PROGRAM
SEVENTEENTH ANNUAL MEETING
OF THE
AMERICAN WELDING SOCIETY
OCTOBER 19-23, 1936
CLEVELAND, OHIO

Headquarters for Technical Sessions and Committee Meetings—Hotel Cleveland

Exposition—Cleveland Public Auditorium

Monday, October 19th

Morning

9:45 A. M. Ball Room—Business Session.
President J. J. Crowe, presiding.
Report on Society Activities by President Crowe.
Teller's Report on Election of Officers.
Award of Samuel Wylie Miller Memorial Medal.
Review of Committee and Section Activities by Chairmen.
Discussion.

Afternoon

2:00 P. M. Ball Room—Technical Session.
A. E. Gibson, Chairman, The Wellman Engineering Co.
E. Vom Steeg, Vice-Chairman, General Electric Company.
Welcome address by local official.
"Fundamentals of Metallurgy of Welding," by E. S. Davenport and Dr. R. H. Aborn, United States Steel Corporation.
"Multi-Layer Oxyacetylene Pipe Welding," by R. M. Rooke, F. C. Saacke and A. N. Kugler, Air Reduction Sales Company.
High speed motion pictures of various welding processes, by E. Vom Steeg, General Electric Company; W. E. Crawford and Walter Richter, A. O. Smith Corporation.

Evening

6:30 P. M. Parlor—Dinner and Meeting Board of Directors.
Review of Society Activities, appointment of committees and officers, new business.

Tuesday, October 20th

Morning

9:45 A. M. Ball Room—Technical Session.
H. M. Boylston, Chairman, Case School of Applied Science.
E. R. Fish, Vice-Chairman, The Hartford Steam Boiler Inspection & Insurance Company.
FUNDAMENTAL RESEARCH IN WELDING
"Heating by the Proximity Effect" by Edward Bennett, The University of Wisconsin.
"The Welding of Copper," by A. P. Young, Michigan College of Mining and Technology.
"Non-Destructive Testing of Welds," by W. B. Kouwenhoven, The Johns Hopkins University.
"Impact Tests of Welds at Low Temperatures," by Otto Henry, Brooklyn Polytechnic Institute.

Afternoon

2:00 P. M. Ball Room—Technical Session.
H. W. Gillett, Chairman, Battelle Memorial Institute.
R. E. Kinkead, Vice-Chairman, Consulting Engineer.
FUNDAMENTAL RESEARCH IN WELDING
"X-Ray Methods for Studying Stress Relief," by John T. Norton, Massachusetts Institute of Technology.
"Welded Beam-Column Connections," by Inge Lyse, Fritz Engineering Laboratory, Lehigh University.
"Circuit Characteristics and Arc Stability," by S. C. Osborne, Wilson Welder and Metals Co., Inc.
"Welded Structural Brackets," by C. D. Jensen, Lehigh University.

Evening

7:30 P. M. Conference and Meeting of Fundamental Research Committee, Bureau of Welding Research and Engineering Foundation.
H. M. Hobart, Chairman, General Electric Company.
This conference is scheduled for university research workers in the fundamentals of welding.

Wednesday, October 21st

Morning

9:45 A. M. Ball Room—Technical Session.
A. F. Davis, Chairman, The Lincoln Electric Company.
C. A. McCune, Vice-Chairman, Magnaflux Corporation.
"Brazing with Silver Solders," by Robert H. Leach, Handy & Harman.
"Importance of Design Control for Welded Piping Systems," by T. W. Greene, Linde Air Products Company.
"Principles of Surfacing by Welding," by E. W. P. Smith, The Lincoln Electric Company.
"Technique for Resistance Welding Ferrous and Non-Ferrous Sheet Metals," by E. I. Larsen, P. R. Mallory Co.

Afternoon

2:00 P. M. Ball Room—Technical Session.
Hugh H. Dyar, Chairman, The Linde Air Products Company.
J. B. Tinnon, Vice-Chairman, Metal and Thermit Corporation.
"Procedures for Control of Welding Parts," by G. H. Moore, Jr., Newport News Shipbuilding and Dry Dock Company.
"Welding Copper and Its Alloys—A Review of the Literature," by Ira T. Hook, American Brass Company.
"Resistance Welding of Dissimilar Metals," by R. T. Gillette, General Electric Co.
"Thermit Welding," by J. H. Deppeler, Metal & Thermit Corporation.
"The Exploration of the Modern Metallic Arc," by L. J. Larson, A. O. Smith Corporation.

Thursday, October 22nd

Morning

9:45 A. M. Joint Session American Welding Society with American Society of Mechanical Engineers.
C. W. Obert, Chairman, Union Carbide & Carbon Research Labs., Inc.
Milton Male, Vice-Chairman, United States Steel Corporation.
"Stress Analysis," by C. H. Jennings, Westinghouse Elec. & Mfg. Co.
"Alloy Steels and Their Weldability," by A. B. Kinzel, Union Carbide and Carbon Research Labs.

Afternoon

2:00 P. M. Joint Session American Welding Society with American Society of Mechanical Engineers.
H. F. Henriques, Chairman, Air Reduction Sales Company.
S. M. Weckstein, Vice-Chairman, Timken Roller Bearing Company.
"Welding Heavy Machinery and Equipment," by C. A. Wills and F. L. Lindemuth, Wm. B. Pollock Company.
"Steel Plate Construction."
"Using Steel Plates for Machine Frames."

Evening

7:00 P. M. Dinner dance with entertainment.

Friday, October 23rd

Morning

American Society of Mechanical Engineers
(American Welding Society members invited)
Weldability of Non-Ferrous Metals:
Copper, Brass and Bronze, Monel Metal, Aluminum.

Afternoon

American Society of Mechanical Engineers
(American Welding Society members invited)
Review of Welding Developments as they affect Mechanical Design.
Welding of Light Machines and Products.
Principles Involved in Selecting Casting vs. Welding.

Metal Congress Exposition, Public Auditorium, Cleveland, October 19 to 24, 1936.

A Review of Recent Wire Patents

(*Continued from page 387*)

M. Horton, Sewickley, Pa., assignor to Pittsburgh Screw & Bolt Corporation, a corporation of Pennsylvania.

In a bolt-blank forming machine, the inventor employs a hammer die and an extrusion die, the latter being formed with a bore of two diameters with intermediate taper and of compound structure, one part comprising a block of great hardness but of little tensile strength mounted within a carrier block of great tensile strength, the portion of the bore of small diameter and the taper being formed in the block of great hardness, the outer part of the extrusion die being formed of softer and tougher material in which is formed a portion of the bore of larger diameter.

✦ ✦ ✦

No. 2,045,103, INSULATED CONDUCTOR, Patented June 23, 1936 by Samuel J. Rosch, Yonkers, N. Y., assignor to Anaconda Wire & Cable Company, New York, N. Y., a corporation of Delaware.

No. 2,045,104, REENFORCED SHEATHED CABLE, Patented June 23, 1936 by Samuel J. Rosch, Yonkers, N. Y., assignor to Anaconda Wire & Cable Company, New York, N. Y., a corporation of Delaware.

The first patent covers an electric conductor having a covering of a wrapping of tape and a body of asbestos interspersed throughout the textile network secured to the tape.

The second patent covers wire enveloped in liquid insulating material and an outer metallic sheath of a metal of relatively low tensile strength, a strip of metal being wrapped about the body of insulation and having a tensile strength relatively higher than the sheath.

✦ ✦ ✦

No. 2,045,277, WIRE BAR AND PROCESS FOR MAKING SAME, Patented June 23, 1936 by Karl A. Lindner, Baltimore, Md., assignor to American Smelting and Refining Company, New York N. Y., a corporaton of N. J.

More specifically, copper wire bars with tapered ends for subsequent working operations are specifically adapted for this process which comprises horizontally casting the bar, milling off the usual oxidized surface of the bar, and further milling off sharp, irregular edges along substantially the entire length of the bar including the tapered ends to prevent formation of surface imperfections in the finished product resulting from the subsequent working of the bar.

✦ ✦ ✦

No. 2,045,544, SPRING STRUCTURE, Patented June 23, 1936 by Angelo Pittoni, Lynbrook, N. Y., assignor, by mesne assignments, to Burton-Dixie Corporation, a corporation of Delaware.

The end coil of each unit comprising this spring structure is hinged to the end coils of adjacent units by having the wires of one coil wrapped around the wire of an adjacent coil and the ends of the spring wires being unknotted and extending into the centers of the spaces framed by the units.

(*Please turn to page 396*)

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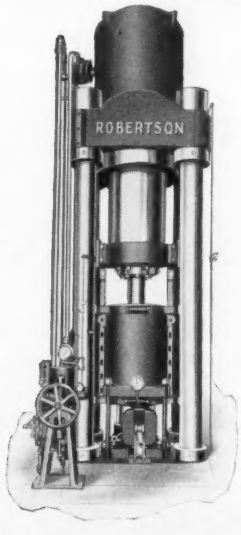

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HOTEL CLEVELAND Cleveland

A Review of Recent Wire Patents

(*Continued from page 395*)

No. 2,045,568, TUBULAR STRANDED WIRE STRUCTURE, Patented June 30, 1936 by Gorman C. Burd, Adrian, Mich, assignor to American Cable Company, Inc., New York, N. Y., a corporation of Delaware.

A tubular wire casting is provided comprising a number of layers of helically coiled spring wire, the outer layer gripping the next adjacent layer. The convolutions are urged to spring outwardly due to contiguous convolutions free from internal stresses.

✦ ✦ ✦

No. 2,045,726, WIRE DRAWING MACHINE, Patented June 30, 1936 by Samuel Hugh Richards, Harpenden, England.

The assembly includes two stepped oppositely rotatable drawing pulleys between which the wire extends in crossed reaches, an elongated cylindrical support parallel with the pulley axes and disposed near the crossing points of the wire reaches, clips adjustably mounted on the support for turning adjustment circumferentially of the same and for adjustment longitudinally thereof, and die-supporting spindles adjustably mounted on the clips and disposed at right angles to the length of the support, the spindles being adjustable in the directions of their lengths and being turnably adjustable about their longitudinal axes, and means for holding the clips and the spindles in adjusted positions.

✦ ✦ ✦

No. 2,046,291, TENSION CONTROL FOR WIRE WEAVING MACHINES, Patented June 30, 1936 by Noah S. Harter, Waukegan, Ill., assignor to Cyclone Fence Company, Waukegan, Ill., a corporation of Illinois.

A tension indicator is provided associated with each warp wire at a point between the device for aligning the warp wires transversely of the machine frame, each tension indicator yieldably holding the wire out of its normal direction and in alignment transversely of the frame when the tension on the warp wires is uniform.

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Some Advantages of Wire Machine Guards

EVEN a layman strolling through a manufacturing plant could hardly fail to be struck by the wide variety of attachments used as machine guards. There seems to be no settled idea about the design of the guards used to protect a particular part of a machine. This may be unavoidable to a certain extent but there is no reason why the wrong material should so often be used. Obviously it is not possible to use wire in every case but many occasions have been observed when it might have been utilized with more efficient results and at a much lower cost. We will not refer much in a short article to the cast machine guards made by the manufacturer to suit his own machinery but rather to the ones made by the plants own maintenance department to suit particular conditions. Almost without exception such guards will be made out of sheet metal or wire.

✦ ✦ ✦

ONE decided advantage a wire guard has over a sheet metal one is that the parts beneath the guard may be seen without moving. Protected part cannot even be oiled without taking off guard because the oil hole is hidden whereas a wire guard does not obstruct the view. A sheet metal guard was once made for a woodworking machine to protect the operators face against flying chips. Often, after this had been in use a short time it resulted in some scrap work due to the fact that the operator was unable at times to watch the progress of the work owing to the interference of the guard. This was removed and a wire one substituted to enable the work to be under observation at all times. This guard proved just as efficient as a chip protector too, and at a much lower cost. It may be seen that a little foresight here would have anticipated the disadvantage of sheet metal under such conditions and saved the added cost of a useless guard.

✦ ✦ ✦

SOMETIMES a guard is more of a warning device than an actual protection, and in most instances of this kind wire will be found the most efficient to use. Special precautions must be taken at times to prevent crashes between modern electric shop trucks, for instance. One shop uses a gate at the intersection of two alleys so that the trucker travelling along this alley must dismount to open the gate before he can proceed to cross the other. This enables him, of course, to see that the way is clear; an automatic device closing the gate after him. By making this gate of wire a light and easily moved obstruction was obtained. It made just as good a protection as a heavier metal or wooden one which, although they would have been stronger, would still be unable to stand the impact of a heavy truck accidentally crashing into them.

✦ ✦ ✦

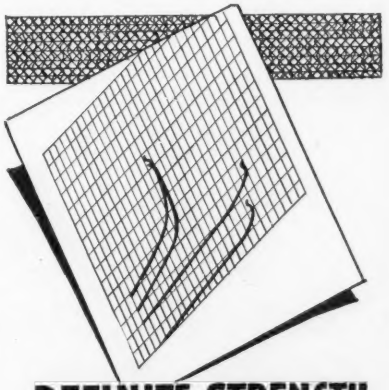
A SOMEWHAT similar guard is the one placed to protect a certain vicinity of a machine but not directly attached to it. Here also wire screen is the best and safest material to use. A sheet metal guard that was placed around a machine was itself the cause of an accident once when a workman tripped over something and fell with his arm on the corner of guard, cutting it badly. Evidently a guard to protect the guard was badly needed here. However, this was made unnecessary by the adoption of wire screen attached to box frames.

✦ ✦ ✦

MACHINE treadles are sometimes provided with a hood like cover to prevent the operator accidentally stepping on them. If such covers completely hide the treadle they make it awkward for the operator who must slide his foot in from the front and feel around, more or less, for the treadle. A paper cutting machine was amply protected at the treadle by a strong wire mask open at the front. The operator could see through the mask, of course, and place his foot squarely on the treadle. Some sheet metal treadle hoods that have come under observation have not been so efficient, as the operator's foot would often slide off either side of the treadle because he was unable to see it. Any dangerous machine operated by a treadle and where the operator cannot be protected in any other way should have a safeguard of a similar kind.

✦ ✦ ✦

WHILE no general rule can be laid down it appears that a wire guard is the best to use unless there is a possibility of it receiving blows more severe than it can resist. Wire can be bent and twisted to suit awkward shapes much easier than sheet metal, it is cheap and easy to handle. But it would be a mistake to think only in terms of wire when machine guards are being considered just as some shops are making the mistake now of thinking only in terms of sheet metal. Both materials can often be used together, a frame of sheet metal with a wire screen making an ideal combination. Neither material then, is likely to monopolize the field but it is the present writer's opinion that wire has not yet achieved its full share of the business of protecting machinery.



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THE publication of the first edition of "Wire Drawing and the Cold Working of Steel" occurred over ten years ago, but in this age of technical development the progress made is so rapid that such a period is sufficiently lengthy to make any text-book out of date, and in the preparation of the second edition of this valuable work the author has not been so much surprised that much has had to be revised, or rewritten, as that any of the text could be left without modification.

✦ ✦ ✦

THE main scheme of the original edition has been retained with its intention of so presenting the subject that it may be of interest to both the wire manufacturer and the wire user. Some matter has been eliminated, but much has been added, notably an entirely new chapter dealing with typical applications of wire; and although some of the old text remains unaltered, every chapter has been completely revised and several entirely rewritten. The volume has also been re-illustrated with a large number of photographs, diagrams and tables. Thus has been brought fully up to date the author's intention to explain the real nature of cold-worked products, and to show how the physical properties required for a particular process may be obtained.

✦ ✦ ✦

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Exports and Imports of Wire

(*Continued from page 389*)

Germany (1,980 square feet valued at $4,251), and Belgium (1,260 square feet valued at $134).

✦ ✦ ✦

WIRE cloth and screen receipts totaled 68,778 square feet (73,412 square feet in April), and came mostly from Germany (45,903), the Netherlands (10,651), France (9,987), and Canada (1,714).

✦ ✦ ✦

FOURDRINIER and other paper-making wire (40,823 square feet) was imported from Germany (25,893), and Austria (14,930), and recorded a decline from the April trade (46,334 square feet).

✦ ✦ ✦

THE 736,000-piece trade in **wire heddles** declined sharply from the 1,517,000 pieces received in April and came from Germany (475,000), and Switzerland (261,000).

✦ ✦ ✦

WIRE fencing and netting, galvanized before weaving, was imported to a total of 60,225 square feet—a considerable decrease from the 529,450 square feet received in April—and came from Germany (54,000), and the Netherlands (6,225). Of the galvanized after weaving grade, Germany (888,750), the Netherlands (203,750), and Belgium (203,750) covered the 1,419,020 square feet trade which compared with 495,525 square feet received in April.

✦ ✦ ✦

EXPORTS of iron and steel wood screws during May, 1936 totaled 24,378 gross valued at $4,226. Of this total the Union of South Africa took 7,621 gross valued at $831; Cuba, 4,911 gross valued at $763; Japan 4,400 gross valued at $1,217; Colombia 1,243 gross valued at $225; Salvador 998 gross valued at $123; Canada 880 gross valued at $172.

✦ ✦ ✦

EXPORTS of brass wood screws during the same period amounted to 4,567 gross valued at $2,057. Of this total Panama took 1,207 gross valued at $407; Canada 921 gross valued at $582; Cuba 920 gross valued at $262; Philippine

(*Please turn to page 403*)

The Design of Mechanical Springs

(*Continued from page 377*)

in fibres nearer to the centre plane or axis. When the spring is then fully stressed, the intensity of fibre stress is not directly proportional to the distance from the neutral axis but approaches that shown in the accompanying diagrams (Fig. 4 and Fig. 5).

✦ ✦ ✦

NO spring material is perfectly homogeneous at the time the springs are coiled and the effect of subsequent exposure to corrosion and fatigue conditons is to increase surface defects. For this reason, the relative efficiencies of spring types shown in Table I must be modified somewhat with the knowledge that the very stress distribution which when equal makes the spring highly efficient, also multiplies the probability of a weak point occurring at a vital locality.

✦ ✦ ✦

RECENT tests on compression springs have seemed to indicate that when the ends are squared and ground, there is a somewhat better distribution of stress if the ends are so positioned as to make the total number of coils in the spring slightly greater than an even number, rather than making the ends of spring come in a direct line parallel to the springs axis.

✦ ✦ ✦

WHILE under ordinary static conditions, the stress in a helical compression spring is evenly distributed throughout all free coils, this condition seldom obtains in valve springs of constant pitch and coil diameter made for high speed engines. For this reason springs of varying pitch or varying coil diameter are frequently used for this purpose.

✦ ✦ ✦

AN extreme case of eccentric loading of a helical compression is illustrated in the use of such a member in flexible shaft or coupling. There are many instances, however, in which eccentric loading occurs through accident rather than by design, and in such cases the maximum fibre stress in the spring material is likely to exceed that calculated.

(*Please turn to page 400*)

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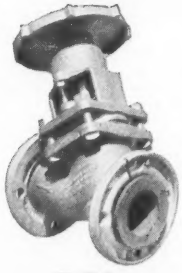

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The Design of Mechanical Springs

(*Continued from page 399*)

MOST of the helical spring formulas set forth in hand books and charts, assume that the stress produced in a helical spring is the same as that which would be produced in a straight bar subjected to the same twisting force. Such an assumption does not allow for the fact that the fibres on the outside of the coil being longer than those on the inside will permit a greater displacement of adjacent sections of the wire with a given stress than those on the inner side of the coil, or since the displacement of adjacent sections must be the same in each case, will permit this deflection at a lower fibre stress than those at the inside of the coil. It will become apparent at once that in closely coiled springs, the difference between the fibre stress in the wire at the inside of the coil and those at the outside may be very material.*

✦ ✦ ✦

IN helical springs having a coil diameter as little as three times the diameter of the wire or rod, the actual stress occuring in fibres at the inside of the coil may be as much as 50% greater than the calculated stress. While some of the more recently published charts and formulas take this fact into consideration, practically none of those published prior to 1929 do so.

✦ ✦ ✦

IT will be seen from the above discussion of cases that are not governed by the common formulas for spring design, that these formulas should be employed only when their use is tempered with a wide experience with the exceptional as well as the usual case of spring design. The method of fastening springs, in some cases, affects further and in no small degree the factors governing the choice of spring design. Where a flat spring of uniform section is employed, for example, the fastening and support may be so designed that as the load is increased and

* This matter is dealt with by A. Röver, "Branspruchung Zylindrische Schraubenfederr mit Kreisquerschnitt", Zeitschrift des Vereines deutscher Ingenieme, 1913, p. 1907 and by A. Wahl in his paper "Stresses in Heavy Closely Coiled Helical Springs" presented at Spring Research Committee of A. S. M. E. meeting Dec. 1928.

the spring deflects the effective length of the spring decreases so that under final deflection, the spring is under a uniform stress throughout its entire length, and its efficiency as an absorber of energy becomes identical with that of the tapering cantilever spring or the helical torsion spring.

✦ ✦ ✦

IT must also be borne in mind by the designer of springs that design and material are indissoluably linked in the matter of spring performance, and that conversely if the conditions under which the spring is to operate are known in advance they may influence the designer in his recommendations and result in a product that is more satisfactory to the user. Some of the factors governing spring design, which have not been fully dealt with in this article are the influence of repeated stress under normal and abnormally corrosive atmospheres, the effect of sudden impact, the effect of scratches and surface blemishes, the period of vibration, the effect of temperature and that of continued stressing. These subjects will be covered in subsequent articles of this series.

✦ ✦ ✦

THIS is the first of a series of five articles by Mr. Rockefeller. Each article will be complete in itself so far as relates to the specific subject. The articles will appear as follows:

Sept. 1936. "Factors Affecting the Performance of Springs."
- **Fatigue**
- **Corrosion**
- **Corrosion-fatigue**
- **Surface defects and stress concentration.**

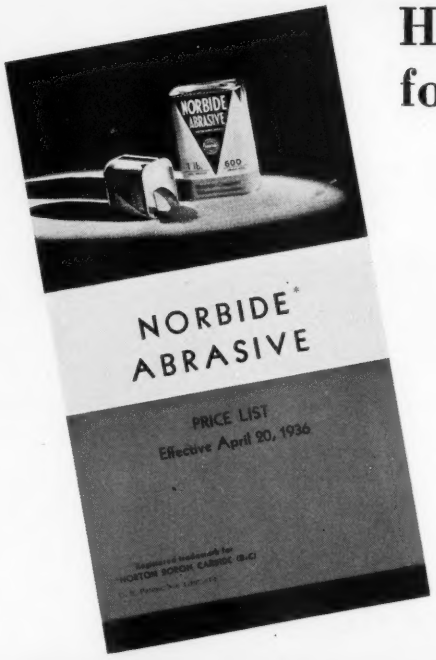
✦ ✦ ✦

Oct. 1936. "Materials for Springs."
- **Steels**
  - **Music Wire**
  - **Annealed Steel**
  - **Premier Wire**
  - **Alloys- Cr.-V. Si-Mn. etc.**
- **Non-ferrous alloys**
  - **Monel Metal**
  - **Phosphor Bronze**

✦ ✦ ✦

Nov. 1936. "Instrument Springs."
- **Considerations important in the design and manufacture of instrument springs.**
- **Extension springs vs. Compression Springs.**
- **The twist of a helical spring under axial load.**

(*Please turn to page 404*)



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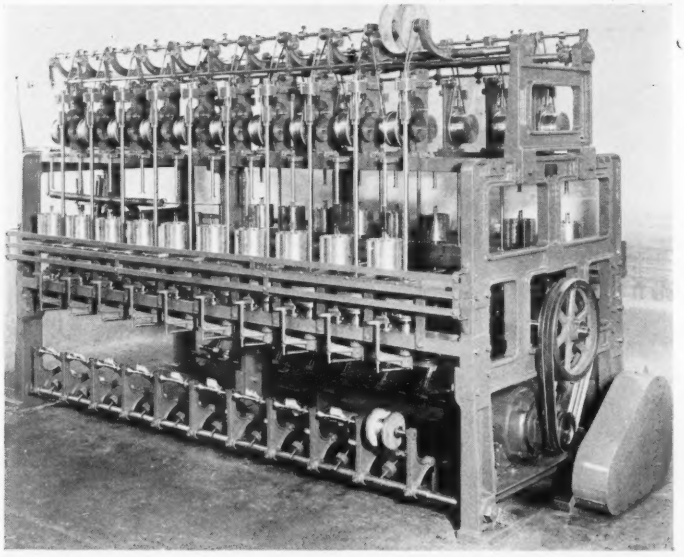

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H. C. Mann Awarded A. S. T. M. Dudley Medal

H. C. MANN, Senior Materials Engineer, Ordnance Dept., U. S. Government, Watertown Arsenal, was chosen as the winner of the Charles B. Dudley Medal for 1936. This medal, which commemorates the name of the first A. S. T. M. President (1902-1909), is awarded to the author of the paper presented at the preceding annual meeting which is of outstanding merit and constitutes an original contribution on research in engineering materials. The medal will be awarded Mr. Mann on July 1 during the 1936 A. S. T. M. annual meeting in Atlantic City.

✦ ✦ ✦

THE winning paper entitled "The Relation Between the Tension Static and Dynamic Tests" presents data and conclusions from an investigation which led to the discovery of a correlation between static and dynamic tests. This correlation involves consideration of the fact that a material in its initial state possesses a certain amount of inherent internal potential energy which, during the process of deformation, is apparently converted to kinetic energy and manifested as increased elastic strength.

✦ ✦ ✦

DATA are presented regarding this internal energy factor which clearly indicate that the mechanism of the process of deformation and rupture is essentially the same under both static and dynamic conditions. It is also shown that since time is required for energy conversions to take place, the total energy value obtained must be dependent on force, time, and space, and therefore to obtain a complete knowledge of the dynamic properties of materials, the velocity of the force application must be considered.

✦ ✦ ✦

MR. Mann, who was educated at Worcester Polytechnic Institute and Boston University, has been at Watertown Arsenal since 1916. From 1928 he has been research engineer in charge of the physical testing laboratory and has recently been appointed senior materials engineer.

Historical Data Relating to Hot Galvanizing Practice for Wire

(*Continued from page 385*)

ture of the zinc dust. He recommended that the best working temperature would be from 500° C. to 600° C. (930° F. to 1112° F.).

✦ ✦ ✦

ANOTHER process which was recommended for wire and which did not prove practical was that of Reese, proposed in 1897. He recommended the use of a centrifuge for galvanizing wire in coils. He stated that 750 R.P.M. was suitable for 20 ga. wire in 10 inch bundles. Lower speeds were advocated for heavier gauge wire. He claims to have coated barbed wire in coils and also wire mesh. The coating of wire mesh to be used, instead of wooden laths, for holding plaster, had been previously described in 1842.

✦ ✦ ✦

Summary

YOU will note from the few examples given, that until within the past fifteen years most of the improvements in the hot galvanizing process for wire, were principally made in equipment and apparatus. Only recently, as was pointed out, have there been changes in the process itself. As a consequence we may safely say that better hot galvanized wire can be produced at the present time than ever before.

✦ ✦ ✦

AS we mentioned in the beginning of this article, we have made no attempt to write an exhaustive history of the hot galvanizing process for wire, but we hope that this brief outline will be of some interest.

✦ ✦ ✦

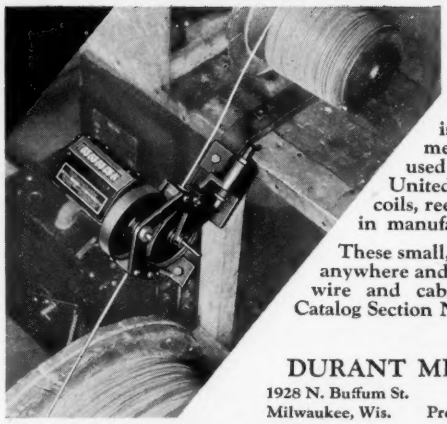
Exports and Imports of Wire

(*Continued from page 398*)

Islands 581 gross valued at $360; Costa Rica 220 gross valued at $40.

✦ ✦ ✦

IMPORTS of wood screws during the same period amounted to 56,858 gross valued at $4,260, of which amount Sweden took 44,658 gross valued at $3,640; Japan 7,200 gross valued at $418; and Belgium 5,000 gross valued at $202.



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Glycerine an Index of Industrial Growth

A reliable "barometer" of America's progress in the manufacture of luxuries and necessities of modern civilization is afforded by the glycerine market, according to N. N. Dalton, in charge of research for the Glycerine Producers' Association.

✦ ✦ ✦

THE United States is the world's largest producer and user of glycerine, Mr. Dalton reveals. With less than ten per cent of the world population, this country produces about one half of the world's glycerine supply. He further points out that we not only use practically all our own production but have imported an average of eleven million pounds per year for the last five years.

✦ ✦ ✦

AMONG other uses of glycerine which have come into larger industrial and household prominence in recent years, Mr. Dalton also points out its growing importance in the manufacture of cellophane and other transparent cellulose wrapping sheets; in the manufacture of an even larger list of commercial foods and beverages; in the making of synthetic resins which are supplanting lacquer for automobile and other protective coatings; and in an increasing number of medical and pharmaceutical uses.

✦ ✦ ✦

Glycerine Fills Place in Mill Operations

UTILIZING glycerine to promote efficient operation of mill equipment and machinery is of interest to every plant engaged in metal working. A number of applications to which this fluid lends itself in the functioning of pumps, gages, and various other heavy mill machines, are listed by Walter S. Tower, Executive Secretary of the American Iron & Steel Institute, on a basis of actual practice within the industry.

(*Please turn to page 405*)

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The Preparation and Microscopic Examination of Metallic Specimens

(*Continued from page 382*)

H. S. Rawdon and M. G. Lorentz Metallographic Etching Reagents I For Copper" Nat. Bur. Stds.—Scientific Paper No. 399 (1920) and II For Copper Alloys, Nickel, and Alpha Alloys of Nickel" Nat. Bur. Stds. Scientific Paper No. 435 (1922).

Proc. A. S. T. M., 1935, Vol. 35, 1935, Part 1, p. 1319, Tentative Standard E3—35T.

✦ ✦ ✦

For references given by numbers in text refer to notes under tables in Part II.

The Design of Mechanical Springs

(*Continued from page 401*)

Mechanical Hysteresis.
Creep under load.
Temperature effect on Modulus of Elasticity—Elinvar and related nickel-chromium steels.
Approved methods of manufacture.
Dec. 1936. "The Manufacture of Wire Springs."
Pre-tempered wire.
Annealed wire.
Heat treating.
Spring Finishes—choice and method of Application.

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✦ ✦ ✦

Glycerine Fills Place in Mill Operations

(*Continued from page 404*)

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Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

CRANES—Cleaning House
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Kelly Wire Die Corp., New York, N. Y.
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Balloffet Diamond Wire Dies Co., New York, N. Y.
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Vanadium Alloys Steel Co., Pittsburgh, Pa.
Vianney Wire Die Works, New York, N. Y.

DIES—Tungsten Carbide
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Vianney Wire Die Works, New York, N. Y.

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John Robertson Co., Brooklyn, N. Y.
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MACHINERY—Magnet Wire
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Elevator Supplies Co., Inc., Hoboken, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

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Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

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H. J. Ruesch Machine Co., Newark, N. J.
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Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

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American Insulating Mach'y Co., Phila. Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry and Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Special—Combination Machine for Drawing, Cutting-to-length, Straightening and Reeling Bars from Coil in One Operation (Shumag Type)—
W. A. Schuyler, New York, N. Y.

MACHINERY—Spooling
American Insulating Machinery Co., Phila.
Elevator Supplies Co., Inc., Hoboken, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, O.
Hallden Machine Co., Thomaston, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Stranding
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

BUYERS' GUIDE, Continued

MACHINERY—Strip Steel
Broden Const. Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Swaging
Elevator Supplies Co., Inc., Hoboken, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Worcester, Mass.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Taping
Amer. Insulating Mach. Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing Size of Wire
R. L. Davis Elec. Co., Wallingford, Conn.

MACHINERY—Testing Wire
Henry L. Scott Co., Providence, R. I.

MACHINERY—Tinsel Rolling Mills
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Welding Wire
Micro Products Co., Chicago, Ill.
F. B. Shuster Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
American Insulating Machinery Co., Phila.
Broden Const. Co., Cleveland, Ohio.
Elevator Supplies Co., Inc., Hoboken, N. J.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry & Machine Co., Trenton, N. J.
W. A. Schuyler, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

MACHINERY—Wire Tinning
American Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.

MACHINERY—Wrapping Wire
W. A. Schuyler, New York, N. Y.

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MONORAIL SYSTEMS—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

OVENS—Annealing or Drying
Lindberg Engineering Co., Chicago, Ill.
Ross Engineering Corp., New York, N. Y.

PAPER—Insulating
E. W. Twitchell, Inc., Phila., Pa.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Delany Chemical Co., Tacony Station, Philadelphia, Pa.
Parkin Co., The Wm., Pittsburgh, Pa.

PICKLING—Tank Linings
American Hard Rubber Co., New York, N. Y.

POTS—Annealing, Case Hardening and Tempering
Lindberg Engineering Co., Chicago, Ill.

POTS—Lead Melting
Farrel-Birmingham Co., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

PRESSES—Hydraulic and Mechanical
Farrel-Birmingham Co., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead
John Robertson Co., Brooklyn, N. Y.

PULLERS—Wire
E. J. Scudder Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
John Robertson Co., Brooklyn, N. Y.

REEL AND TENSION STAND—
Sleeper & Hartley, Inc., Worcester, Mass.

REEL CRUTCHES
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
Mossberg Pressed Steel Corp., Attleboro, Mass.

REELS—Impregnating
Mossberg Pressed Steel Corp., Attleboro, Mass.

REELS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

ROD BAKERS—
Morrison Engineering Co., Cleveland, O.

RODS—Wire—Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.
Seymour Mfg. Co., Seymour, Conn.

RODS—Wire—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

ROLLS—
Farrel-Birmingham Co., Ansonia, Conn.

RUST PROOF COMPOUND
American Lanolin Co., Lawrence, Mass.

SHEET—Steel
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Superior Sheet Steel Co., Canton, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, O.

SOAPS—Wire Drawing
Gore, T., Brooklyn, N. Y.
R. H. Miller Co., Homer, N. Y.

SPOOLS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Brass, Zinc and Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.
Seymour Mfg. Co., Seymour, Conn.

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TESTERS—Wire
Henry L. Scott Co., Providence, R. I.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS
H. J. Ruesch Machine Co., Newark, N. J.

VALVES AND FITTINGS—Acid Proof
Duriron Co., The, Dayton, O.

VULCANIZERS
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS
American Insulating Mach'y Co., Phila., Pa.

WIRE—Cold Heading
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Youngstown, O.
Youngstown Sheet & Tube Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.

WIRE—Electric
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Enameled For Coils
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Co., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio

WIRE—Nickel Silver and Phosphor Bronze
Hudson Wire Company, Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Non Ferrous to Specification For Special Purposes
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel and Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Seymour Mfg. Co., Seymour, Conn.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE AND STRIP—Brass, Zinc
Platt Bros. & Co., The, Waterbury, Conn.

This is a carefully classified index of concerns who specialize in this industry and who advertise regularly in WIRE & WIRE PRODUCTS. Please mention WIRE when writing to these firms.

THE WATSON MACHINE COMPANY

ESTABLISHED 1845

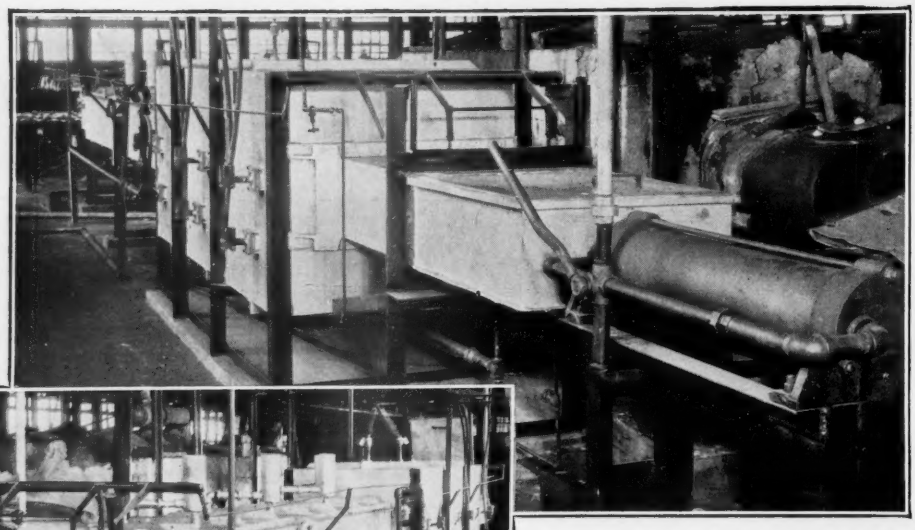
PATERSON, NEW JERSEY, U. S. A.

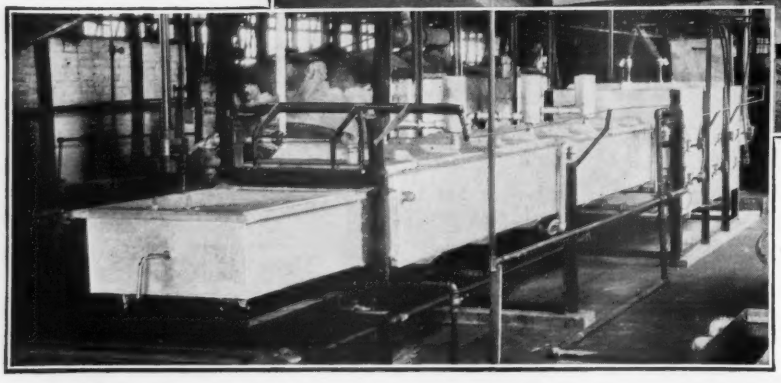
Electric Cable and Wire Rope Machinery:

STRANDERS	Planetary & Rigid Frame types (*horizontal and vertical.*) High-Speed Tubular and Built-up types.
BUNCHERS	High-speed types for spools up to 1500 lb. capacity.
ARMORING MACHINES	For Wire (*planetary type*) and for Tape.
PAIRING & TRIPLING MACHINES	For Bare & Insulated Wire.
CLOSERS	For Wire in Planetary, High-speed & Angular types.
CLOSERS & CABLERS	For electric cable in Planetary and Angular types.
TAPING MACHINES	Eccentric and Concentric types, for Paper, Friction and Varnished Cambric and Burlap types.
TAPING HEADS	For applying steel tape in Eccentric and Concentric high-speed types.
JUTE & BURLAP	Applying Heads.
THREAD SERVERS	For Cotton, Asbestos, etc. application on hose and wire.
COMPOUND TANKS	Electrical or Steam heated for machine or unit application.
CHALK APPLIERS	Wet and Dry types.
CAPSTAN SECTIONS	With Single tapered and double grooved wheels, with Lay Control by gears or variable speed transmission.
LET OFF REEL STANDS	Shaft and Shaftless types, for any size of reels.
WINDERS	For steel and copper, in single or multiple head units.
COILING MACHINES	Power or manual drive for package coiling—also for warehouse and shipping room use.
COILING HEADS	For wire rope and insulated wire and cable.
TAKEUP STANDS	Inclined frame, Shaftless and Heavy-duty types.
TRAVERSES	Light and Heavy, manual, mechanical and motorized.
TEMPERING & GALVANIZING MULTIPLE HEAD TAKEUPS	For wire.
MEASURING MACHINES	For Length Measurement.
ELECTRIC PATCH VULCANIZERS	
SATURATING, WAXING & GREASING TANKS	Gas fired and Electrical.
WIRE TINNING MACHINES	Gas fired and Electrical.
CABLE PEELERS	For removing lead sheathing and insulation.
POLISHING HEADS	Separately or Motor driven.
REEL CRUTCHES	For turning heavy reels in handling and shipment.
MOTORIZED WINCHES	For general duty in cable and rope plants.
CUTTERS	For wire rope, cable and chain.
SPOOLS	Heavy-duty for Rope-Mills and Cable-plants.

Send for descriptive catalogue.

ELECTRICAL WIRE AND CABLE—WIRE ROPE AND CORDAGE MACHINERY





Above—Charging end of continuous furnace bright annealing fine copper wire on spools.

Left—Discharge end of above furnace. The wire is discharged bright, dry and uniformly annealed.

Bright Annealing Copper Wire

Uniformly, Economically, Continuously,--Bright and Dry

Another continuous controlled atmosphere furnace (similar to above) was recently installed for bright annealing fine copper wire on spools. No steam, vapor or water seals of any kind are used in these furnaces—thus staining is entirely eliminated and no drying necessary,—the wire is delivered from the furnaces uniformly annealed, bright and dry ready for shipping, further processing or fabricating.

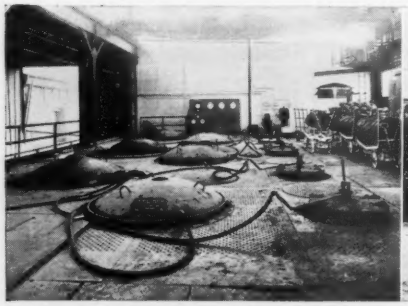
The above type of furnace—built for several prominent wire manufacturers—is one of several types of electric and fuel-fired furnaces we developed and built for the wire industry—both ferrous and non-ferrous.

Other recent installations include furnaces for clean annealing brass wire—an improved pit type furnace for normalizing and annealing steel wire in coils, as well as furnaces for scale-free hardening, billet heating, bright annealing, brazing, carburizing, and other heating and heat treating processes.

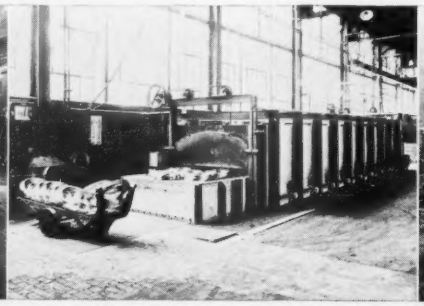
If you are interested in improving the quality of your anneal or heat treatment, increasing production or are contemplating any changes or additions to your furnace equipment, our engineers will be glad to work with you. We specialize on building furnaces to fit the customer's particular problem.

The Electric Furnace Co., Salem, O.

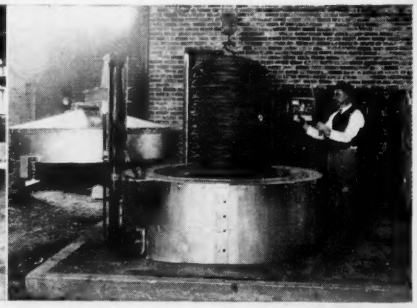
We Build the Furnace to Fit Your Job---For Oil, Gas or Electric Heat



Normalizing Rod and Bright Annealing Wire.



Clean Annealing Brass Wire in Coils.



Annealing Steel Rod and Wire in Coils.